NATURE MAGAZINE

February, 1948 50 Cents Vol. 41, No. 2

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Nature in Print

By HOWARD ZAHNISER

TWO AUTHORS choosing wildlife subjects, and writing the sort of fiction that conveys truth more effectively than does matter of fact, have recently been concerned with the results of storms. In a Pennsylvania setting Joseph Wharton Lippincott creates, at the outset of *Black Wings: The Unbeatable Crow,* a springtime burst of wind that left broken limbs "lying in every direction" and in the course of its havoc split the forked ash that was the nesting tree for a pair of crows, blew their bulky nest to the ground, and started on his career the fledgling that was to become Caw-Caw. Out in Jackson Hole, Wyoming, Sally Carrighar sees, as the dramatic focus of the events in her *One Day at Teton Marsh,* the September storm that came "swinging down from Canada," bringing the equinox, and in its most violent blow striking and throwing over the dead cottonwood that was the pier of a beaver dam that had created the world inhabited by the characters of this book. The narratives developed from each storm are indeed a windfall for their readers, for each work is an even more than to be expected legacy for their respective audiences.

Mr. Lippincott, says the publishing house of which he is president, writes for "any reader from the age of 11 up," yet it is obvious that he himself has been thinking carefully of those who are not too far up. It is true that no one can fail to find *Black Wings* interesting and meaningful, yet adult readers in their characteristic moods will probably find themselves going lightly through some parts of this story that will be of intense interest to younger readers.

Other parts are surely for all readers, for Mr. Lippincott writes after many years of observation in the outdoors, and he writes vividly and with a simplicity that is eloquent for all. Who, for example, can fail to appreciate such a paragraph as this:

"There were many animals in and around the wood that night: several muskrats and two coons used the brook as their pathway, a red fox chased a big rabbit twice through the bushes and later yapped in one of the clearings to call his mate, white-footed mice and shrews scurried among the dead leaves and a flying squirrel sailed from a hollow oak to alight at the fork of a poplar where she had cached a supply of the tree's seeds. . . . There were also plenty of sounds that night, rustlings and squeaks, the calling of screech and barn owls, the yapping of the lonely fox, and the growling of the quarrelsome coons."

In fact, it is only in the handling of his human characters that Mr. Lippincott has been essentially juvenile in his writing of *Black Wings.*

This is the story of the young crow rescued from the storm's disaster. Taken to a farmer's home, named Caw-Caw, and adopted into the farmstead, the young bird grows to maturity, then is lured away to a mate in the wilds, and years later returns for old age to the farm. Intertwined with the crow's story is enough of the story of the farm children, and of the neighboring farm children, to lend a human interest to the book, particularly in the young folks with whom boys and girls can identify themselves. Added to the pet-crow narrative is enough of the bird's experiences in the wild, dramatic and too-true experiences as they are, to present a complete and properly exciting account of this great wild creature. This aspect of *Black Wings* will surely be of interest to any outdoor reader, and all will appreciate the value of Mr. Lippincott's fair representation of the much-persecuted crow, the more so knowing that he has written with so much attractiveness for young readers.

In "A Foreword on the Crow" the author suggests that the crow's "beneficial acts . . . fully balance or perhaps outweigh his depredations," and he summarizes the facts that support the suggestion. "Without more than 50 years' experience with crows," writes Mr. Lippincott in this foreword, "including those that I have raised and tamed, and without records of the contents of the stomachs of dead wild ones that I have examined at almost all times of day and all times of year, I would not try to write on this subject." It is apparent that Mr. Lippincott's knowledge and understanding, as well as his sympathetic interest and his story-telling skill, are much to be commended to those seeking a good book for the boy or the girl, and no adult should ignore any good chance to read it.

Long ago Gilbert White observed that "the investigation of the life and conversation of animals is a concern of much . . . trouble and difficulty, and is not to be attained but by the active and inquisitive." We thus have a considerable debt to such a writer as Mr. Lippincott who has shown us so much of the "life and conversation" of the crow, and we most assuredly do also to Sally Carrighar, than whom it is difficult to imagine anyone being more "active and inquisitive" in preparation for writing. This was evident in *One Day on Beetle Rock;* it is demonstrated again in the even better *One Day at Teton Marsh.*

Yet Sally Carrighar, in the diligence of her devotion, has been more than active and inquisitive. She has likewise been deeply reflective and, schooling her creative imagination thoroughly in natural history, has written with the conscience of an artist. The result is rare literary creation. Undoubtedly an older child could read with interest *One Day at Teton Marsh,* for it tells its wildlife stories in simple language and short sentences, yet no child could sense all its meanings, and there is no reader, even among the most cultured, who could not read it with enrichment and admiration.

Here transpires a dramatic day, and we live it with the otter —precisely that, for Sally Carrighar, with the same art whereby the novelist gets within his characters, has actually enabled us to live a day within the consciousness of the otter. And then we re-live the same day, the same events, the same acts of the marsh's wild creatures, again and again, but always differently, for we re-live it with the cutthroat trout, and then again with the osprey, the mosquito, the scud, the mink, the varying hare, the American merganser, the moose, the clepsine leech, the leopard frog, the physa snail, the trumpeter swan, and the beaver. And when we have finished we are amazed at how sharpened is our apprehension of what living is and how broadened is our comprehension of life.

Here in *One Day at Teton Marsh* is the same device of art that Miss Carrighar herself invented for *One Day on Beetle Rock,* the same device that one hopes she can carry to all the wildlife habitats we know. For only the device is the same, and the new work has all the freshness of the new setting. In fact, *One Day at Teton Marsh,* surely to Miss Carrighar's great satisfaction, goes even beyond *One Day at Beetle Rock* in its attainment, for it has a more fluently beautiful prose and it expresses a more profound understanding of the meaning of the quality of wildness, of life in its elemental reality. The short

Woods-Struck

By J. A. ALLARD

Near my cabin on Lake Rangley
There's a spot affects me strangely,
Where the red deer comes a-thirsting
To the sandstone springs a-bursting,
While the whippoorwill's shrill scolding
And the evening shades enfolding
Bring to me a most revealing,
Singular, primeval feeling:
I revert in savage glee
To an aborigine.

sentences that Miss Carrighar so skillfully writes are in *One Day at Teton Marsh* less conspicuously precious individually, and the rhythm of the writing is thus the more sweeping and broader. The events in the lives of the wild creatures are less a subject for mere observation and simple integration in narrative, and much more something pondered and related not only to each other but to the all.

"Going away, abandoning all the destruction, would have been easier. [For the beaver.] But instinct is not so simple in its objectives. More often than intellect, possibly, it requires the hard choice. The command is to wait, and to grope, to labor, to risk life, as frequently as it is to indulge oneself; and not only for the beaver. The other animals, too, followed instinctive discipline to the good ways that work permanently. That is what wildness is—to follow the inner impulse without wilfulness, and sensitively."

Surely there is no reader of this page who will not wish to possess *One Day at Teton Marsh* and who will not follow with rich eagerness the further development of this already accomplished artist, who, fortunately for us, has chosen to fashion her art out of the lives of wild creatures and to derive her impressions of wisdom from her experiences with wildness.

Black Wings: The Unbeatable Crow. By Joseph Wharton Lippincott. Philadelphia and New York: J. B. Lippincott Co. 1947. 144 pp., with frontispiece in color and 21 drawings by Lynn Bogue Hunt. $2.50.

One Day at Teton Marsh. By Sally Carrighar. New York: Alfred A. Knopf. 1947. viii + 239 pp., with end-paper pictorial map and 24 drawings by George and Patritia Mattson. $3.50.

Kennel Building

Kennel Building and Plans. By Will Judy. Chicago. 1947. Judy Publishing Company. 94 pages. Illustrated. $3.00.

This is an enlarged and revised fourth edition of this book, which covers construction for dogs, whether of a one-dog dwelling or a building to house scores of canines. The illustrations present plans, layouts and pictures of actual kennels.

Nature Hobbies

The Book of Nature Hobbies. By Ted Pettit. New York. 1947. Didier. 280 pages. Illustrated by Don Ross. $3.50.

From a wide variety of sources the author of this useful book has gathered information about some two hundred Nature activities that have been proved by test to provide enjoyment and information to those interested in Nature. Also, these activities, or hobbies, afford the follower more than the mere identification and scientific name of species, whether plant, bird, mammal, insect or other form. The author has one purpose, "to help you find out more about the world of nature, and to have fun doing it." He feels that too many programs place too much emphasis on identification alone, and too little on how plants and animals live. He feels that such a course too often kills off a budding interest in Nature that might be stimulated into a lifelong hobby, or even a vocation. His book seeks, therefore, to avert such stifling of interest, and the author has certainly succeeded in gathering together a generous amount of stimulating and practical material.

Tycho Brahe

The Life and Times of Tycho Brahe. By John Allyne Gade. Princeton, N. J. 1947. Princeton University Press for the American-Scandinavian Foundation. 209 pages. Illustrated. $3.50.

The year 1946 was the four hundredth anniversary of the birth of Tycho Brahe, Danish scientist whose scientific accomplishments kept pace with his eccentricities. Brahe, a member of the Danish Court, was principally an astronomer, and in his time there was a close fellowship among scholars in Europe, with the result that the Dane's scientific contributions are liberally recorded in works in European libraries. His personal life and interesting character, however, are not so widely detailed in readable and available texts, least of all in English. Mr. Gade has filled that literary and biographical gap, and has given us a fascinating story of a fascinating individual. At the same time the author recreates a picture of the times of Brahe. Altogether this book constitutes a biography that any reader will find enjoyable, even one who may never have heard of the unpredictable Dane.

Fire Leaflet

"Wildfire" is the title of the latest Cornell Rural School Leaflet to come to hand, and it is a notable addition to the series. Dealing with wild fires of various kinds, their vagaries and their destruction, this leaflet should plant in the minds of students and teachers a real appreciation of the fire problem. Many will not realize that there is so much to be written about fires, even the real extent of the damage that they cause, both economic and in point of natural resource destruction.

Smithsonian Bulletins

Three recent bulletins of the Smithsonian Institution, Washington, D. C., have more than the usual popular interest. These are: "Life History of the Quetzal," by Alexander F. Skutch, reprinted from *The Condor;* "The Sun and the Harvest of the Sea," by Waldo L. Schmitt, text of the 14th Arthur lecture: "The Natural History of Whalebone Whales," by N. A. Mackintosh, reprinted from *Biological Reviews.*

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To Stimulate Public Interest in Every Phase of Nature and the Out-Of-Doors, and Devoted to the Practical Conservation of the Great National Resources of America

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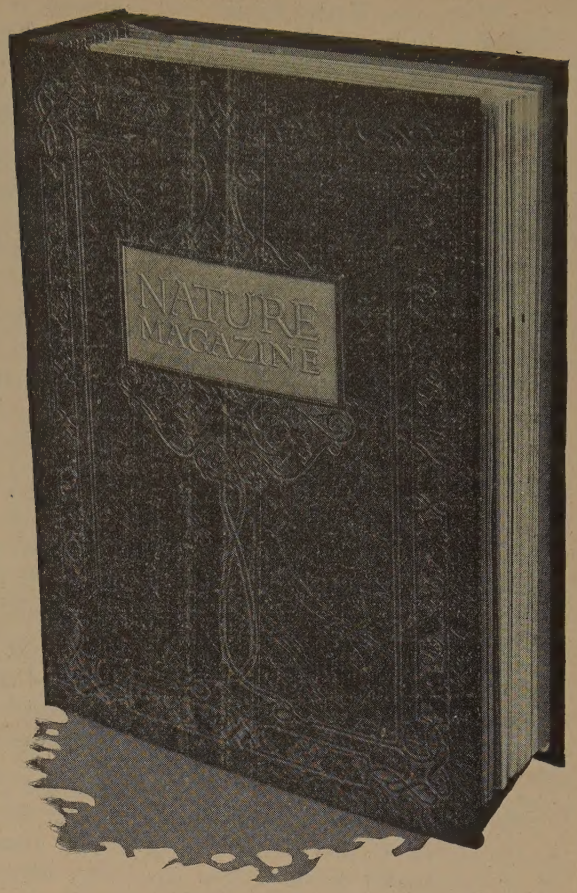

"Where's the latest copy of Nature Magazine?" How often you have heard that question! And how often an answer like this: "Look on the chair . . . over in the corner!" Like as not, the much desired copy will turn up under the cushion in the window seat. And great will be the lament at torn pages and creased pictures.

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Then the Rains Came

In early November, 1947, John M. Cummings wrote one of his penetrating editorials in *The Philadelphia Inquirer* under the title "Rains Saved the Forests but Doomed Small Game." Seeing the parched fields and woods, he said, one wished that the rains would come. Then, realizing that the hunting season was to be postponed because of the fire danger, one rather hoped that the rains would not come. But rain it did, and on the last day of October the Governor lifted the ban. The next day "the carnage started on schedule." Wrote Mr. Cummings:

"Pheasants that called so hoarsely in the early morning and which brightened the fields and the roadsides throughout the sunny fall days, are no more. Other small game in the fulness—or the briefness—of time, will feel the stinging hot pellets of the brave and hardy nimrods.

"We saw the three men cross the fence about 150 yards away. Their red caps, hunting jackets, tight-fitting pants and high laced boots conspired to give them a formidable appearance as they started across the field, each with the barrel of his shotgun pointing to the ground, but ready for quick elevation.

"For some reason or other they made no effort to fan out. They crossed the field in a close-together group, a little dog trailing at their heels. Later, doing a chore in the barn, that ol' woman of our'n being indisposed, we heard a terrific bang. Looking through the loft window we could see the three hunters, delicate wisps of smoke still issuing from their guns.

One, a faster runner than the other two, was chasing something in the heavy grass. Then we saw the object of the hunt. A pheasant managed to get a few feet into the air. Then it fell back into the thicket. The bird was wounded. Its time was up.

"The man nearest the stricken pheasant closed in. From the shaking of the grass, as the bird struggled, we knew it was still alive. The brave hunter reached down. The bird, trying to get away, flapped its one good wing. The hunter pulled back. It would be foolhardy to take chances with a wounded pheasant.

"Now the other hunters were at the wounded quarry. The three surrounded the bird. The dog came up and barked. One of the hunters struck at the pheasant with the barrel of his gun. At length one, let's call him an intrepid hunter, picked it up by the legs. It struggled a little; but life was fast ebbing. While one hunter held up the bird, a second hit it repeatedly. He used the gun barrel as a bludgeon. Again and again the bird was struck on the head.

"In a minute or less the pheasant hung limp and lifeless in the grip of the hunter.

"We turned away, wishing the rains hadn't come.

"What we saw in the field was sportsmanship. It must have been sportsmanship of a high order, too, for these hunters were decked out like models in *Field and Stream*. In fact, you might say they were dressed to kill.

"These are days of terror for the pheasants and for all other creatures whose lives may be legally taken during the open season. It's an open season for murder. A few brief weeks to indulge in the ancient love of the chase and satisfy the blood lust.

"Some men who go into the woods and the fields must be sportsmen, at least to a degree. They can't all be bloodthirsty louts who delight in torturing their prey after it has been rendered helpless.

"It must be a great thrill to kill a pheasant, a squirrel or a rabbit. Driven from cover by a trained dog or the heavy foot of man, the slow-flying pheasant is an easy target. Maybe the thrill comes from chasing the crippled bird in the grass and belting it over the head with a gun.

"Later on our great hunters will enjoy the thrill of the big game season. They'll go to the upland country, then, to get deer. And the fallen buck, with big lustrous and wondering eyes, will take a last look at the hills that were his home. And in his dying gasp, he, too, will wish the rains hadn't come."

CITY SQUIRREL

By VIVIEN B. DAILEY

A gray squirrel, living in Elmira, New York, believes not only in living in the city, but in doing as the city dwellers do. He gets his provisions from a grocery like his two-footed neighbors.

When a grocer across the street from the squirrel's favorite tree put some bushel baskets of walnuts out in front of his store, the little fellow went to work. In the space of a couple of hours, the shrewd little hustler had carried away about fifty walnuts.

The squirrel displayed his city training each time he crossed the street with a nut, waiting patiently at the curb until traffic had all passed before scampering across. That particular thoroughfare is a busy one, but the squirrel never grew careless and never took the unnecessary chances humans do.

When a dog appeared on the scene and gave chase, the squirrel eluded him without difficulty. On the next few trips he crossed the street by running up a telephone pole, skipping nimbly across the wires and down on the other side. Eventually the dog grew tired of this, and trotted away. The squirrel then returned to the land route.

Although his antics attracted quite a crowd, the little animal ignored his audience. With a gold mine like that within his grasp, he could not afford to waste time on mere people.

When school was dismissed and the children discovered what was going on, they crowded close until a friendly policeman cautioned them to give the little worker plenty of room.

In spite of the fact that the squirrel threatened to deplete the supply of nuts, the proprietor of the grocery made no move to protect his stock.

The following day found everything quiet in the neighborhood, but on the third day the squirrel was back on the job. Again he worked busily gathering his provisions from the basket in front of the grocery, never forgetting to be cautious in crossing the street, and paying no attention to the interested onlookers.

Now the proprietor of the store is wondering how many walnuts it takes before a squirrel is satisfied.

Do Birds Hibernate?

From the times of Aristotle, Pliny, and other ancients, it has been asserted that certain birds hibernate. Some of the accounts, as of swallows wintering in mud under water, seem utterly incredible, yet there have been persons who swore to the actuality of this phenomenon. Klein in 1750 published the affidavits of numerous witnesses in East Prussia, and in Sweden, a hundred years later, the matter was investigated by the National Zoological Museum, which reported that the question was not yet entirely settled.

In our country, claims of the occurrence of that type of dormancy are on record but more frequent are tales of swallows, swifts, and parakeets wintering in dry places, as hollow trees. While, on the ground of possibility, this type of winter sleep is more acceptable, it has never been scientifically demonstrated. That chimney swifts can become torpid for a period and later recover full activity, I know from experience, and entirely reputable people have testified that they have seen swifts coming alive into rooms in winter, from chimneys where they must have been dormant for weeks. The ability to become torpid and revive also has been proved among hummingbirds.

To sum up, some birds can become torpid, awaken, and live, but there is no definite evidence as yet that they ever survive a full season of genuine hibernation.—W.L.M.

Dominican Republic

Journey toward the Sunlight. By Stanley Walker. New York. 1947. The Caribbean Library. 226 pages. Illustrated. $2.75.

The West Indian island that is now the Dominican Republic was the first country in the Western Hemisphere to be touched by European civilization, and in this book Stanley Walker presents an interpretive study of that country today.

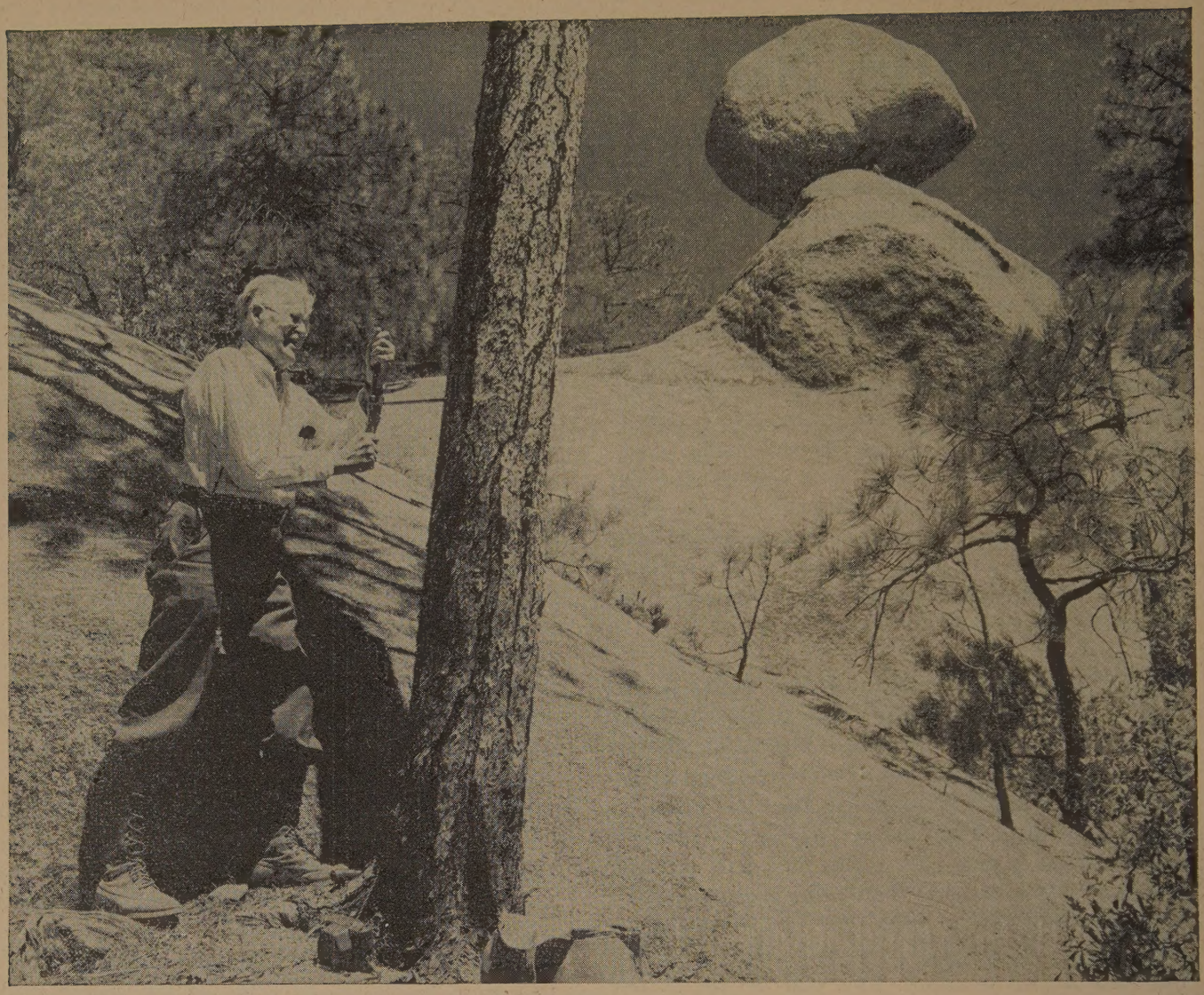
Contents Noted

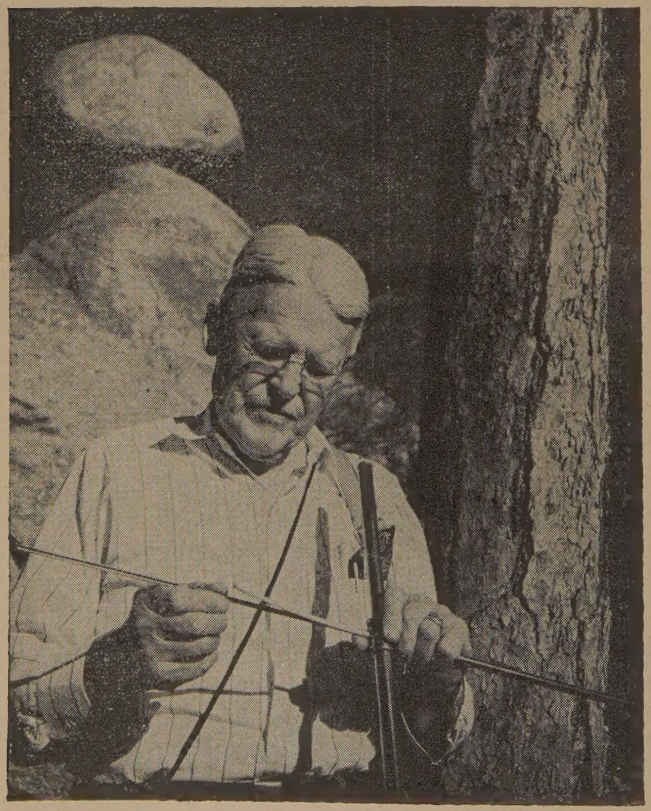
TACKLING the problem of soil reconstruction in soil-depleted sections of the Southeast, Department of Agriculture scientists have found that blue lupine makes a splendid cover crop. A half-million acres have been planted to this plant and yields of 45,000 to 50,000 pounds of lupines to the acre are not uncommon of good sandy loam. This is computed as equal, for fertilizer, to more than one thousand pounds of sodium nitrate. However, the bitter blue or alkaloid lupines are unpalatable to livestock; in fact, too much might be dangerously poisonous. Economic botanists no longer let things like this bother them, for they set about developing tasty lupines that will be good eating for animals and good cover crops as well. Sweet strains of yellow lupines with high protein value have been developed, and one or two varieties will soon be ready for distribution to farmers from the botanical production line.

BELLIGERENT jealousy on the part of ruffed grouse has been used by wildlife technicians to simplify the temporary incarceration of these birds so that they can be banded and marked for research purposes, reports the Wildlife Management Institute. Glenn L. Bowers and Dean Ward Tanner, working in Pennsylvania, devised a trap with a trip door and an eight by ten mirror as the only "bait". The gadget is placed on a drumming log or drumming site. Along comes the grouse, spots what appears to be another grouse poaching on his territory. This will not do, so the combative bird moves into the trap to do battle, and there the bird stays until he is banded. Through this the research men seek to learn facts about the dispersal, mortality and territorial habits of the birds. In order to keep the trap from being used for improper purposes it is said to be a closely guarded secret among wildlife managers. This is interesting, and, doubtless, plausible to many, but it is also strongly reminiscent of studies long pursued in New England, New York and elsewhere, only now with a new gadget. The fact that grouse gunners have long known altogether too much about grouse dispersal and territorial habits, and can and do attend to most of the mortality, is ignored. And the "closely guarded secret" is amusing. How, indeed, could improper users be prevented from spotting the traps just as easily as the trap-setters can spot the drumming logs?

JACK Hambleton, in his column, "The Outdoor Trail", in the *Toronto Globe and Mail*, has a faculty for airing well many wildlife conservation problems, and recently he took up the question of aerial poaching. With meat in the United States at fancy prices, it appears that winged poachers have been flying over moose country, spotting animals below, landing on a lake, getting a moose and flying out to dispose of the more than half ton of animal at a dollar a pound. Some night clubs and fancy eating places in the States have been offering moose steak at three dollars and up. Something must be done to control this attack upon a fast-disappearing animal, says Hambleton. And, he points out, it is not only a matter of moose-mooching, for "there were a lot of planes up around James Bay before, during and after the goose shooting season this year, too, and in at least one case one big-name United States 'sportsman' was nailed with a plane load of geese." We are happy to say that this hog was prosecuted and fined. Hambleton calls for a fact-finding study, and urges that not only the Provincial Air Service, which has twenty-eight planes, should have its pilots as deputy game wardens, but that commercial pilots should be given the same status. Sportsmen, poachers and fur-trappers from the States are complicating things in Canada, and this activity is also going on without anything amounting to proper regulation on this side of the border as well. We need a fact-finding commission ourselves, and prompt regulation of this modern racket.

MISCELLANY: A boy's air rifle or B.B. gun is not a "dangerous" weapon, according to the decision of a judge in a District of Columbia court, dismissing action brought against two hardware dealers charged with selling such guns without a license to deal in weapons. We would risk being in contempt of court to remark that a person who had lost an eye from one of the things might differ, as would the many song and insectivorous birds killed by boys whose parents have unwisely provided them with this "toy." . . . From the U. S. Fish and Wildlife Service comes a release urging all hunters to utilize all game meat as a food-saving project. We were under the impression that the reason gunners go afield is to keep alive memory of the struggle of their hardy ancestors against the wilderness. Or could it be that, after all, they kill just for the sake of killing? . . . As a result of an emergency survey of the reason for the recent "red tide" of the Gulf Coast of Florida comes the report that this was due to the appearance of extraordinary numbers of a microscopic sea creature, known to science as *Gymnodinium*. Individually these minute animals are invisible to the human eye; when they get together in quantity the pigment granules within each organism turn the sea water reddish or amber. And the things give off a deadly toxin, the chemical character of which is not known. This is fatal to fishes and other aquatic animals. The poison also irritates the human mucous membranes when carried on wind-borne spray. Means of foretelling appearance of the red tide are being sought. R. W. W.





Dr. Andrew E. Douglass on a field trip in the Catalina Mountains near Tucson, Arizona. A tree has been located in a "type site"—a place where the tree's water is supplied exclusively by rainfall. Dr. Douglass bores into the tree to take out a core that will reveal the information he seeks. The exact location of the tree is carefully noted. Other things being equal, trees growing in similar type sites in a given area will accurately reflect rainfall by the patterns of their tree rings. At the left Dr. Douglass makes measurements and calculations from the core he has taken from the tree, as one would take the core from an apple. Bisecting the tree's diameter, this core will contain a line separating each ring—each ring representing a year in the life of the tree.

On the facing page, against the impressive backdrop of a section of 2000-year-old California redwood, Dr. Douglass explains his science of dendrochronology to a visiting scientist from Brazil, Dr. A. P. Pereira. Seen close up, the redwood has a chart keyed to historic dates, and with lines running from a certain ring to a certain date in history. For example, one ring was being formed when the Vandals took Carthage in 439, A.D.; another in 1271, when Marco Polo began his travels; others in 1492 and 1620.

Tree-Rings Tell a Story

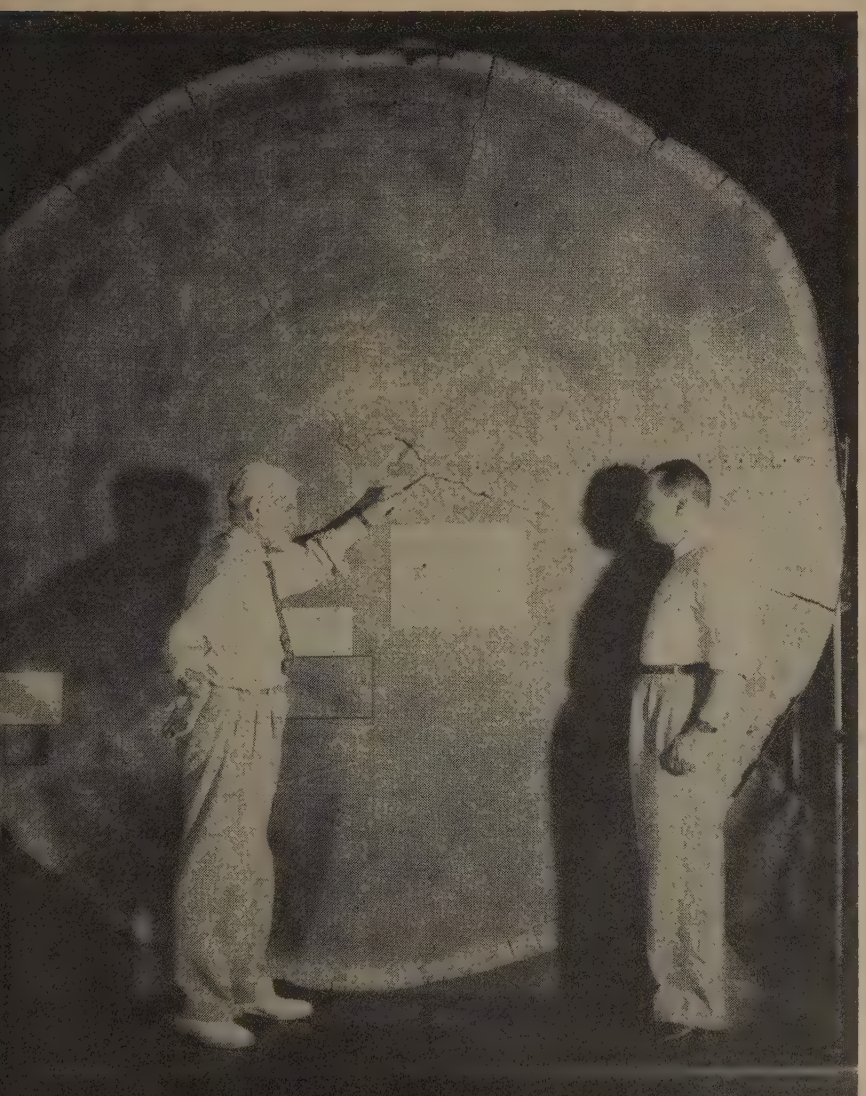
By BETTY MASSINGALE NELSON

Photographs by Charles W. Herbert from Western Ways

A NEW kind of calendar has been developed in the Southwest since the turn of the century. Unlike other records of time, which date forward, this one dates backward. It is known as Dendrochronology, or the science of tree-ring timing.

For centuries, men have known that the age of trees can be determined by the number of rings in the trunks, and Leonardo da Vinci noted the difference between rings formed in wet and dry years. It remained, however, for Dr. A. E. Douglass of the University of Arizona to discover and develop the potentialities of a tree-ring calendar that dates back to 11 A.D. in northern Arizona, and back to 1306 B.C. in the giant sequoias in California. A record of the past has been deciphered, in part, as dendrochronologists have learned to read the story written in the tree trunks. Signs and glyphs placed each year in layer after layer of wood cells, which form the annual rings of growth in the pines and Douglas firs of northern Arizona, tell the story of climate through the years.

It all began back in 1901 when Dr. Douglass, formerly associated with the Lowell Observatory at Flagstaff, Arizona, was making a wagon trip down from the forested top of the Kaibab Plateau, more than 8000 feet in elevation, to the desert of House Rock Valley. En route he had time to observe the effects of the weather on the vegetation at different altitude levels. Being an astronomer and a physicist, Dr. Douglass set out to investigate a possible correlation between the sunspot cycles and the ring growth in trees. This primary problem of solar-terrestrial relation has been evasive, for Dr. Douglass has found a variety of cycles that are frustrating in theoretical possibilities, and he still is working on his initial theory. In the meantime he has discovered data of tremendous value to various sciences. The result is a record of thousands of years of historical changes in climatic conditions, the annual changes of which were accurately dated.



To understand the method of cross-dating, by which the tree-ring calendar has been built, it is necessary to understand how a tree grows. The ring of a tree is an annual phenomenon, each ring representing a season's growth. The normal growing season of trees in the temperate zones, where best results are obtained, is from spring until fall. The spring wood, which is the light colored inner part, is made up of large cells. As summer progresses, the new cells are smaller and thicker-walled, until finally growth ceases entirely. These small cells form the dark line of summer wood, and give protection to the tree during the winter months. Growth then ceases until the following spring, when a new, light ring is begun.

Naturally, the growth of trees of the same species varies for a number of reasons. The amount and type of soil, the mineral food, the amount of sunlight, temperature, humidity, and water must be taken into consideration. For this reason, in comparing ring patterns, it is necessary to use trees cut from an upland area, or from locations in which —in the Southwest—scantiness of water supply is an obvious part of the environment. The amount of snow that melts

Doctor Douglass' associate, Edmund Schulman, prepares a sample under a camera lens before recording its rings on film.

in the spring, and the annual rainfall on well-drained slopes, are seen easily by the trained eye. It has been noted that widespread variations in the amount of rain and snow cause the same response in trees over wide areas from year to year.

Cross-identification, or cross-dating, is the matching of patterns in large numbers of trees from the same area. These tree-growth ring patterns may cover slightly different and yet overlapping periods of time. Thus, the inner rings of a newer tree should match the outer rings of an older tree, if those two series of rings were formed during the same span of years. No two trees are exactly alike in all growing conditions, but they can be almost exactly alike with respect to climate and water supply if areas are selected with regard to the maximum effect of these factors. This is true in the dry Southwest. It is less common in more moist climates. Thus, it is the relative sizes of the rings in relation to neighboring rings that give the true picture of wet and dry years in a dry area. The cross-dating of these wet and dry rings provides assurance of the climatic origin of those changes, and, at the same time, makes possible the construction of centuries-long chronologies without a single error of date.

The presence of false rings in a specimen sometimes complicates cross-identification. Recognition of these false rings requires experience, and they must be identified beyond question before dating can be established. An interruption in the supply of moisture, or some other condition that temporarily slows the growth of the tree, will cause the false rings. A drought commonly occurs between the time the snow melts and the usual summer rains come in Arizona. Then, unfavorably situated trees sometimes grow the small, dark, thick-walled cells like summerwood, but these are distinguished easily by the fuzzy and blurred composition of their outer edges as compared with the sharp outer edge of the annual ring.

During very dry years, some trees growing in the unfavorable locations may fail to add any ring at all. However, it is unusual when no cells are added. If the pattern of a specimen matches exactly the patterns of neighboring trees, with the exception of one ring, and the other trees show a very faint ring indicating drought, then it is assumed that the one tree failed to add a ring because of lack of moisture. For this reason it is noted that there is a tremendous difference between ring count and ring chronology.

So, by matching specimens from living trees with beams in old houses, and older beams from prehistoric ruins, it is possible to build a calendar. Each piece of old wood that successively matches and overlaps a dated piece in pattern adds to the calendar. Such a chronology can be carried back as far as old wood is found. Close to a million rings have been matched to date. Each ring of modern trees has been compared with several hundred different trees. This number decreases to a dozen or twenty as one goes back through some seventeen centuries.

In many instances, as in very old ruins, a chronology is found to recur in several locations, yet nowhere does it overlap known dates. This is designated as a floating chronology because it has not yet been anchored to our calendar. Extreme caution is used in dating the wood.

Cone-bearing trees in Arizona have been the most datable, yet only one type of juniper has been of any use. Ponderosa or yellow pine, Douglas fir and the pinyon pines are the most revealing. It has been noted that the double rings seldom occur in the firs, but are found frequently in the pines at their lower levels.

A study of hemlock rings has been made in New England, and in California the giant sequoias have given evidence of long-time cross-dating. Research is most successful in regions where the usual life of the tree is from 200 to 500 years. Not all trees can be studied. Trees in the tropics are not usable at the present time because of a lack of climatic variation. Some other means of studying their growth may be worked out in the future. Other localities in which scientists have begun to study tree-rings are in Sweden, Norway, Germany, Alaska, and in Yellowstone Park, the mid-west, Ohio and Georgia.

Specimens from living trees and old logs are compared more easily by means of a tubular borer, which cuts out slender cores. The cores then can be taken to the laboratory for complete analysis without the removal or destruction of the entire beam or trunk.

A standard system of making a graph for any de-

sired specimen has been worked out so that when that specimen is compared to a pattern plot, or master graph, for a given time interval, matching lines are recognizable, sometimes easily and sometimes after long study.

To study the cycles occurring in the tree-rings, Dr. Douglass invented a cycloscope in 1913-14. With this he wished to study cycle length directly, as the cycloscope gives automatically and almost immediately a pattern that can be read in terms of cycle lengths and their changes. The cycloscope has rendered important service in demonstrating a relationship between cycles in tree-rings and sunspots. Thus far, Dr. Douglass has not published any definite conclusion in his present studies of solar-terrestrial relation.

One of the most valuable contributions of the tree-ring science has been to archaeology. By cross-dating wood cut from trees of different ages, definite dates have been given to pre-Columbian pueblo dwellings found in Arizona, New Mexico, Colorado and Utah. This sounds simple, but behind it lie heartbreaking years of unsuccessful results. Various archaeological expeditions and scientific institutions, quick to realize the value of substantiating dates arrived at by pottery evidence, contributed wooden beams and charcoal bits found in the ruins, and floating chronologies were established for many abandoned pueblos.

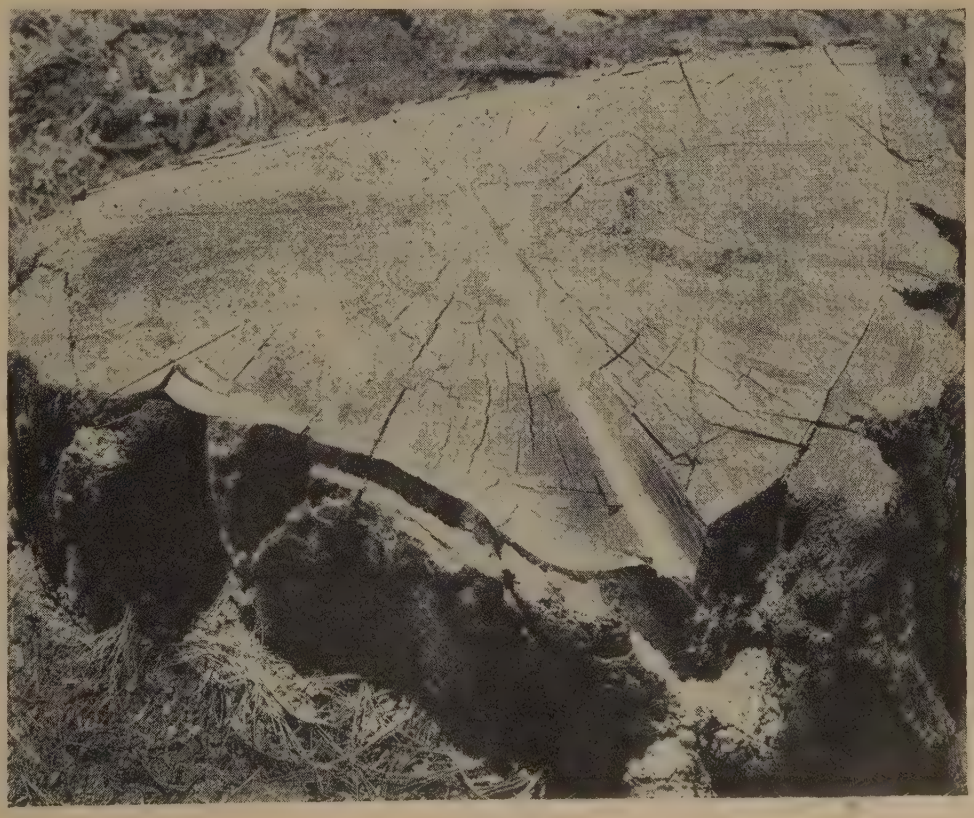
Undaunted by discouraging results, and faced with a gap in the various chronologies, the men worked on. Finally, in the early summer of 1929, a charred beam excavated at Showlow, in eastern central Arizona, proved to be the missing link. This connected the floating chronologies, which were found to have stopped just before 1300 A.D., and others beginning at, or a little before the same year. This discovery was made by Dr. Douglass, aided by Neil M. Judd of the National Museum, Lyndon L. Hargrave of the Museum of Northern Arizona, and Emil W. Haury, who is now head of the department of anthropology at the University of Arizona. It is considered by some to be comparable to the discovery of the famous Rosetta stone, which gave the key to Egyptian hieroglyphics.

Actually there was an overlap of some 20 years in the gap, but the confusing issue was due to a tremendous drought that extended from the year 1276 to 1299. Many rings were microscopic, and only under the lens could their pattern be determined. Many rings were absent. This was because of the then unknown dry period, which was later discovered to have had far-reaching effects on the people of that vicinity.

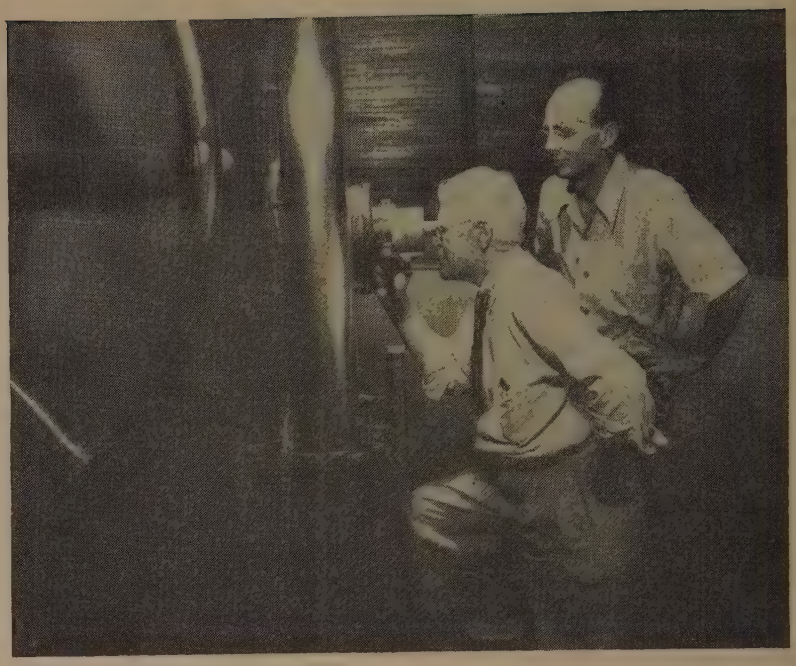
It is believed that large forests used to exist in the Pueblo Bonita region, where many of the abandoned villages were located, leading to the supposition that a microclimatic change took place. The destruction of this forest had an important influence on, if it did not cause, the drying out of the Chaco region, with a resultant decrease in its power to support human life.

Speaking of the dating of the ruins by tree-rings, Dr. Douglass says: "We regard the dates of the tree-rings as precise to the exact year. However, the archaeological datings derived from rings usually have some small correction because of the possibility that the wood was cut one or more years before being used in construction."

The great drought at the end of the thirteenth century, which caused all the trouble in the building of the calendar, was probably the most severe of all those recorded to date. Next in magnitude was one that came three hundred years later, from 1573 to 1593; after another three hundred years there was a third major drought, starting in 1870, taking on a drastic character from 1894 to 1904. All were followed by periods of abundant rainfall. If the sequence follows a three-hundred-year cycle, there should have been a similar drought about 1000 A.D. The tree-rings fail to show anything more than rainfall definitely below



Here is an ancient stump from which a slice, sufficiently long and deep, has been sawed to reveal the story of the tree-that-was.



Dr. Douglass is primarily an astronomer, despite his fame as a dendrochronologist. Here, with Dr. Paul Jose, he gazes into the eye of a telescope at the University of Arizona's Steward Observatory. Currently Dr. Douglass is testing a theory that there may be some relation between sunspot cycles and tree ring cycles.

normal at that time, however. These three-hundred-year intervals were interspersed with smaller frequent droughts, which failed to fall in any set pattern. Since Nature cannot be changed, it is hoped that a thorough study of the history of climate will offer some guide to reclamation projects and the preservation of forest cover. Such data are extremely valuable in Arizona, where the water level is sinking rapidly. So we find in the tree-ring calendar a climatic chronology that not only aids the reclamation engineer, but gives the student of climatology some of his most fundamental material for the formation of climatic theories.

Data of considerable value in hydrology have been collected and described by Dr. Edmund Schulman, an associate of Dr. Douglass. Dr. Schulman studied and correlated the run-off in the Colorado River basin with tree-rings formed simultaneously in a great many localities throughout its watershed. He then was able to determine what the run-off had been from about the 13th century up to the present day by comparing modern tree-rings with those several hundred years old. Dr. Schulman's object was to determine whether a basis could be established for reasonably accurate estimates of frequency of recurrence of periods of excess, or, particularly, sub-normal water run-off in the river basin. Such information can be used by hydrologists in connection with their studies to determine the amount of water that can be expected to drain into Lake Mead above Hoover Dam. In a desert country, where water and power are vital problems that must be examined from every angle, all factors contributing to a knowledge of potential water supplies are extremely important to residents there.

In the tree-ring laboratory at the university, Dr. Douglass and his staff are surrounded by various pieces of wood that look as though they had been cut only yesterday. It is startling to realize that many of these pieces are hundreds, even thousands, of years old, and that many of them were cut with stone axes for roof beams. One interesting fact was that one of those beams from the ruins of pre-historic dwellings was used when Dr. Douglass was called to testify in a law-suit challenging the durability and strength of Arizona pine as lumber.

Thus has the science of tree-rings been developed. Its potentialities have only begun to unfold. As one of the infant sciences, it has already made remarkable contributions to botany, meteorology, ecology, geology and archaeology. Additional data turn up regularly. Possibly, in another thousand years, scientists guided by research of Dr. Douglass and his associates will add their evidence of tree-ring study and discover startling information. Languages may come and go, nations and civilizations will rise and fall, but the trees write an indelible record of the climatic world in which they live, and science can read that of Nature.

Be Careful

By LURENE BROWN

Be careful of the creatures of the wood,
  The furry little things that somehow find
Their path upon the highway and then stand
  In frozen terror as your headlights blind.

Be careful! How their hearts must pound with fear
  As you approach, a monster with strange eyes!
Futility, this nightly battle wages—
  Fragility against gigantic size!

Be careful lest another night's grim toll
  Shall be revealed with the advancing day.
These soft small creatures die because you pass
  And fail to yield to them their right of way.

One-Man Nature Center

By EDWIN WAY TEALE

Photographs by the Author

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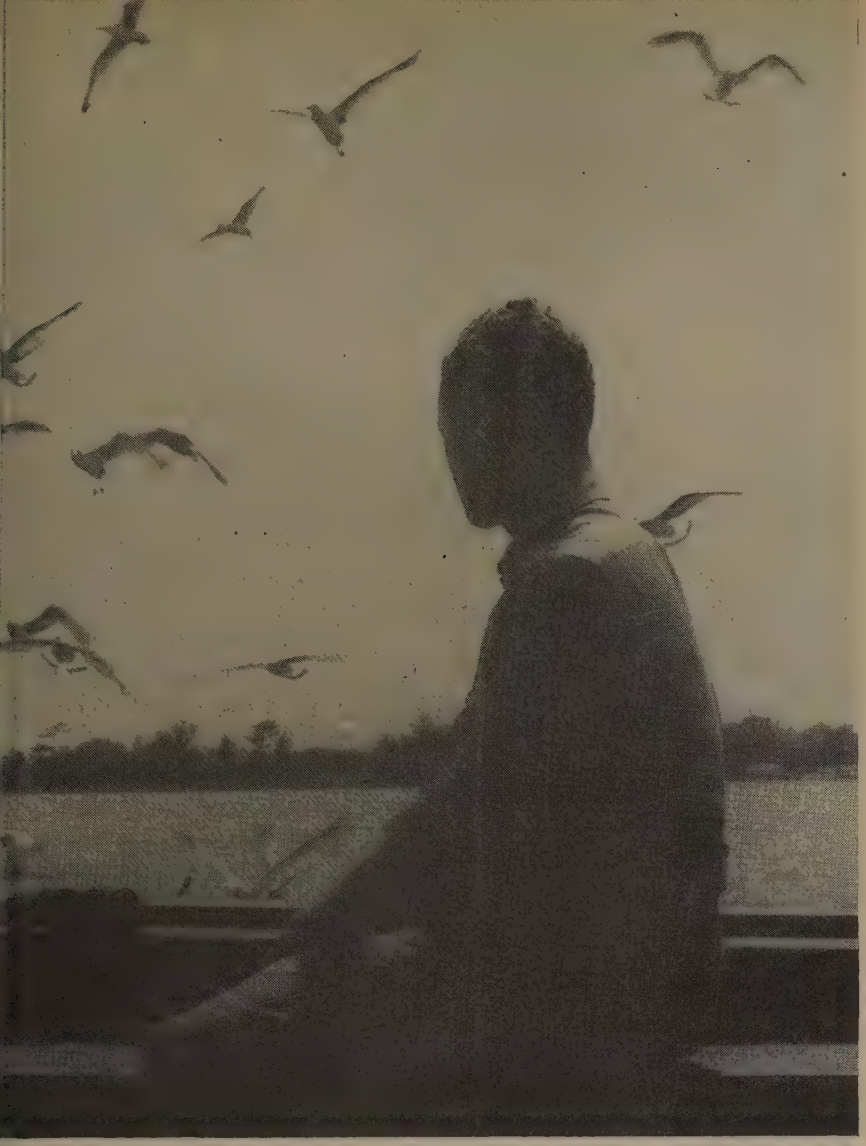


Ring-billed gulls follow McKay's strange boat, eager to get the bits of bread he always takes with him, and which the gulls have become accustomed to expect. Birds of the floating islands, including egrets, bitterns and herons, let the boat come much closer to them when it is surrounded by the gulls, and the Nature cameraman has a fine chance to get pictures.

Less than twenty miles south of Gainesville, Florida, the main highway skirts Orange Lake. If you swing to a side road here and drive half a mile east, you come to one of the most interesting natural history spots in North America, Don McKay's one-man Nature center on a lake of floating islands.

For more than ten years, McKay has been hanging doggedly to an idea. As we cruised about in a curious boat of his own design, one day last spring, he told me of this long battle to realize his dream. He came to Florida in the mid-thirties. An earthquake at Long Beach, California, the previous year, had dropped a brick wall on his automobile-cleaning machinery and put him out of business. Interested in natural history, he began exploring Orange Lake, an extensive body of shallow water celebrated for islands that drift with the wind. An ambition soon developed. He determined to set up a Nature center and guide tourists to the birds, the plants, the exotic wildlife of this remarkable spot.

Without help and without capital, earning money as he has gone along, he has stuck to his plan. He bought his first piece of property for twenty-five dollars. This gave him a toe-hold at one of the few good landing places on the lake. Gradually he extended his holdings, buying, bit by bit as he earned the money, adjoining pieces of land. Now he has four acres of ground, several frame buildings and a 400-foot frontage on the lake. The setting is primitive and picturesque. To add to the attractiveness of the main building, McKay has draped strands of Spanish moss over the weathered boards. Eventually, he hopes to have a photographic laboratory, a microscope room and a museum, as well as floating gardens and a Nature trail. The Nature trail is already under construction. When completed, it will carry visitors under moss-hung cypresses, past spike-barked "toothache trees," beside a sink-hole and along the shore of the lake, with its birdlife and its gardens of water weeds.

Most of the money that has financed the Nature center so far has come from an odd source—sun-power heaters. A few years ago, McKay devised a reflecting mechanism for using the sun's rays for heating hundred-gallon tanks of water for Florida homes. All told, he has built in his spare time and sold more than two hundred of these solar heaters. At no fuel expense to their owners, they provide hot running water for houses in several parts of the state.

The unique "floating island" boat, which McKay designed and built, was financed by the sale of some

of these heaters. When he showed his plans to a professional shipbuilder, he was told the craft would cost more than $3500. Although he had never built even a rowboat before, McKay—after visiting shipyards and reading books on boat-building—constructed the boat himself at a cost of hardly more than a quarter the estimated price. This shallow-water craft is twenty-six feet long and nine feet wide. Flat-bottomed and with a tunnel stern, it can carry twenty-five passengers and still navigate in two feet of water. Both bow and stern are squared off and provided with steps so visitors can obtain closeup views of life on the floating islands. The roof of the boat is a solid platform, a photographer's deck providing a vantage point for Nature-cameramen who wish to shoot movies or stills of the wildlife around them.

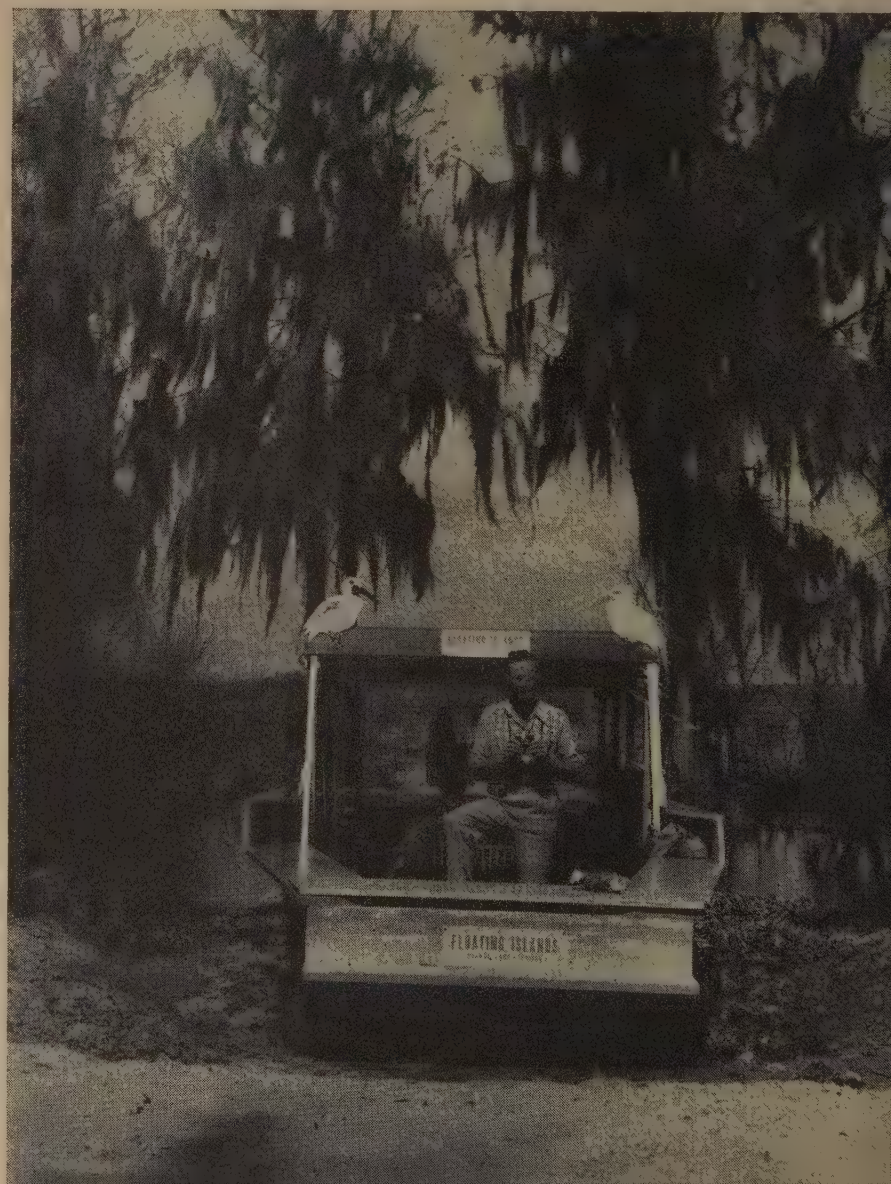
An excursion on McKay's boat is a natural history adventure you never forget. It is a high point on a Florida trip. As soon as you move out from under the lofty cypresses, with their festoons of waving Spanish moss, you are surrounded by a cloud of ring-billed gulls. On each trip, McKay takes along several loaves of bread to feed the gulls. They recognize his boat and come flying the moment it begins to move. Not only are these birds interesting in themselves, but, while they are circling around the boat, other shyer birds will let it approach without taking alarm. Escorted in this manner, you can sometimes get within less than ten feet of an American bittern.

Boat-tailed grackles fly to join the avian picnic. One of the grackles I saw had lost all of the feathers in its tail. In spite of this, it was able to fly, although it was apparently incapable of stopping suddenly or veering swiftly. It would shoot past a piece of bread, unable to check its pace, while the other birds fluttered and dived and retrieved the food.

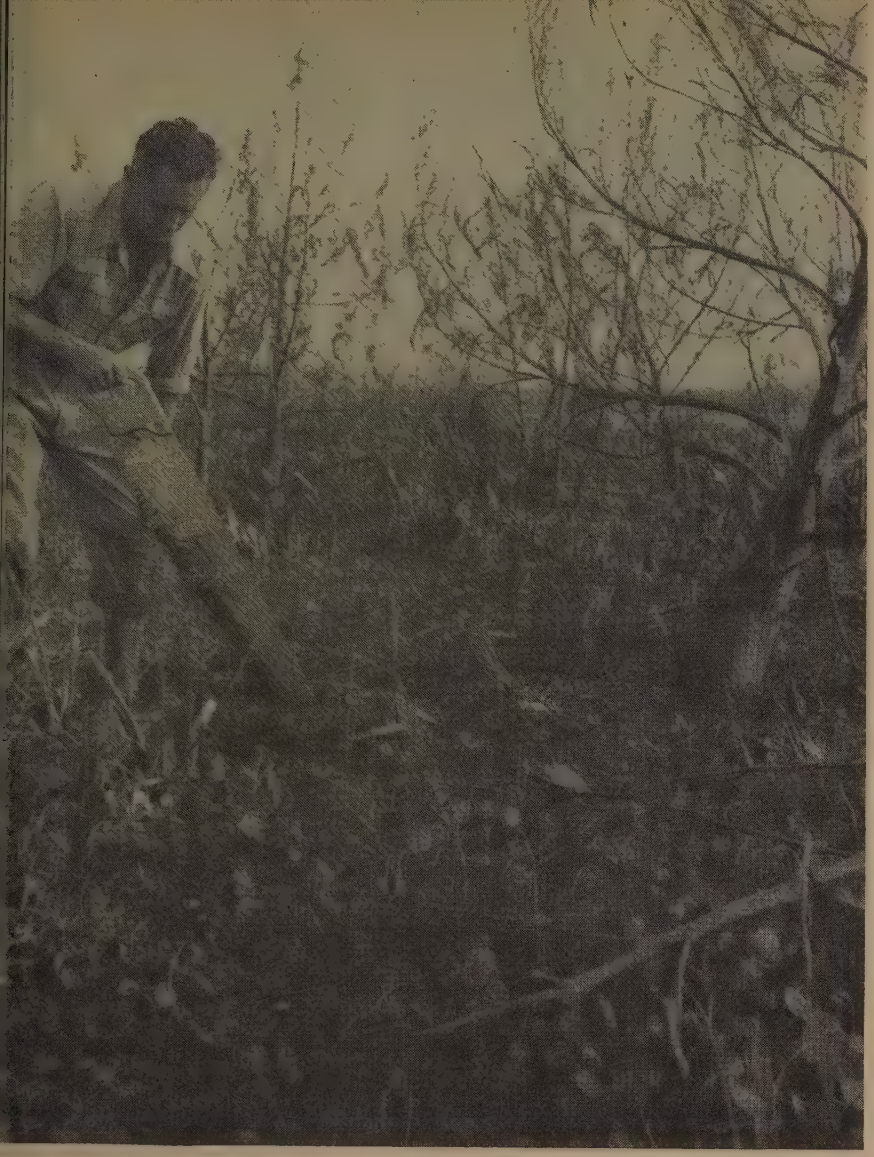
Coots and pied-billed grebes dabble in the shallows, wood ducks wing swiftly past, and, overhead, an osprey circles, with a bald eagle keeping watch in the distance. Purple and Florida gallinules skitter away over the water vegetation as you approach. Gallinules, McKay tells you, are jealous guardians of their nests during the breeding season. Each gallinule patrols an area of about thirty feet around its nest. It flies to the assault if any living creature dares enter its domain. He has seen these birds fearlessly rush toward large and deadly cottonmouth moccasins when these venomous water snakes came near nests containing young birds. The gallinule attacks the serpent's tail. It pecks repeatedly with all its might, at the same time avoiding the fangs of the reptile. In this way, it puts the cottonmouth to flight. Although it continuously guards the surface of the lake around its nest, the gallinule pays no attention to birds nesting in bushes almost directly overhead. Its territory is the lake surface; other birds "own" the air above it.

Such reminiscences, coming from McKay's years of observation on Orange Lake, add much to the interest of the trip. You pass permanent islands where colonies of snow-white American egrets are nesting, and you see snaky-necked anhingas, or water-turkeys (pictured on Nature Magazine's cover this month), fly past, alternately flapping and gliding. During the courting season, McKay has seen the male anhingas perch in treetops and wiggle-waggle their wings as each female flew over, not stopping until she was beyond their sight.

From time to time, the boat plows through areas where the surface of the water is thick with the great,



Don McKay built this special Nature boat himself. It will carry twenty-five persons and can cruise in water only two feet deep. The top forms a solid platform from which Nature photographers can operate their cameras.



Sawing an island in two. Don McKay cuts through one of the floating islands, which are usually two or three feet thick. Once the boat was penned in by islands and it was necessary to saw a channel to set the craft free.

flat leaves of the yellow pond lily or spatterdock. When McKay pulls one up, the stem comes out of the water like a long green cable, six or seven feet from end to end. These stems ascend from thick, spongy roots, sometimes twenty-five feet long, embedded in the mud of the lake-bottom. It is these roots that form the raw material of the most dramatic feature of Orange Lake—its floating islands.

Crisscrossing in the mud, the roots form an almost solid mat, sometimes as much as a quarter of a mile across. They are buoyant with gases. Occasionally, during a storm, one of these mats will break loose and rise to the top, carrying a section of the lake-bottom with it. Thus, a floating island is born.

Seeds sprout on the mass of drifting mud and roots. In time, it is covered with vegetation. Usually the largest of these land-rafts break up soon after they reach the surface, but in some instances they remain intact. Eventually, of course, the original spatterdock roots decay and drop to the bottom. But, by that time, other buoyant materials hold the island on the surface. One of these wandering islands on which I stepped has been drifting about the lake as long as McKay has known the region.

Bushes and even trees grow on the larger islands. One cypress tree reached a height of twelve feet and a water maple rose even higher. If a tree gets too big, the ground under it is unable to support its weight and it drops through a hole into the lake. In other instances, where high bushes or trees have risen on a relatively small land-raft, winds have heeled the whole island over in the manner of a capsized sailboat. I saw the edge of one floating mass that looked as though it had been turned up by a plow. The wind had tipped over a line of bushes along the edge, curling up the whole side of the island.

When a breeze is blowing, bushes and higher vegetation on these unanchored islands act as sails, and the masses drift as much as three or four miles in a single day. The islands are natural derelicts and change their positions continually. McKay once anchored down a floating island by means of cables and concrete blocks. That kept it in place for a while, but finally it broke free and resumed its drifting.

The buoyancy of one of these land-rafts is greater in summer than in winter. Sometimes an island will sink a foot or two below the surface, or even descend to the bottom during cold weather, only to rise to the top again when summer comes.

Because of its unique design, McKay's boat can nose up on the edge of a floating island to permit examination at close range. In the plentiful moisture and rich muck, many plants spring up to giant size. You see goldenrods that are five feet high, brown-eyed susans as tall as a six-foot man, bulrushes rising to seven feet, and immense pigweeds that tower nine feet in the air.

We landed near one of these giant pigweeds and found the base of the stem more than a foot in diameter. As McKay walked about on this floating island, the ground rose and fell under him. Like portions of the great Okeefenoke Swamp, it was a Land of the Trembling Earth. Once McKay's foot went through a weak spot almost up to his knee. In midsummer, the acid muck stings like biting ants when it touches bare skin and haste is made to wash it off.

A friend of McKay's once dropped clear through an island, disappearing in the mud and water. He popped up again like a cork and scrambled into the boat in fear that an alligator might be lurking be-

A boat-tailed grackle and a red-winged blackbird feeding on the leaves of the spatterdock. It is the great spongy roots of these water plants that produce buoyancy.

neath the land-raft. Close by the pigweed, we noticed a mound of moldering vegetation, apparently the remains of an alligator nest of years before. At one time these saurians were common on Orange Lake. During the war years, however, hunters riding in air-driven boats virtually wiped them out.

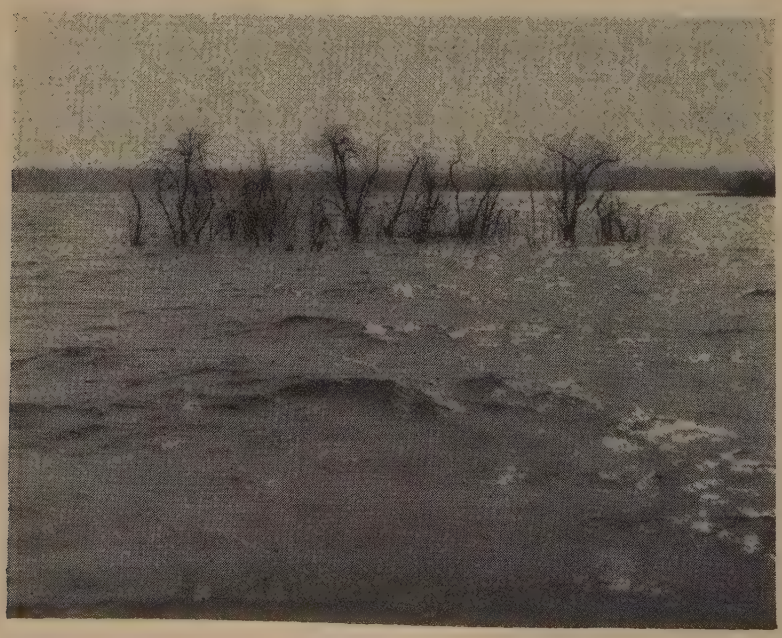
How thick are these floating land-rafts of Orange Lake? The average is put at between two and three feet, with a few having a thickness of five feet. This makes possible one of the strangest operations on record—sawing an island in two. On board his boat, McKay always carries a long cross-cut saw. Twice he has had to use it to free himself when drifting islands hemmed him in. A few years ago, he was clearing out the mouth of Cross Creek—made famous by the book of his friend and neighbor, Marjorie Kinnan Rawlings—where it empties into Orange Lake. A stick of dynamite loosened masses of spatterdock roots and new-born floating islands popped to the surface all around him. Before he could start for home that afternoon, he had to saw through more than a hundred yards of roots and soil. He and a helper sawed away for hours before they freed the boat.

At certain seasons of the year, the floating islands of Orange Lake are fragrant with masses of spider lilies in bloom. Purple loosestrife grows in profusion, and elderberry and buttonball bushes take root, as well as wax myrtle and sawgrass. Around the edges, where the islands are almost awash, there is a fringing of arrowhead, smartweed and other water-loving plants. Willows are usually the first trees to take root on a floating island that remains adrift for any length of time, and becomes relatively permanent in the lake.

We passed one island with a filmy crown of green willow bushes. Out of them poured a noisy flock of grackles and redwings, circling about in excitement. Many kinds of wildlife dwell on every floating island. Frogs plop into the chocolate-brown water at your approach. Insects rise out of the vegetation. Turtles that have clambered aboard the drifting land-masses to sun themselves slip into the water again. Water snakes make their home here, and swamp rabbits sometimes swim out to the islands to escape their enemies on shore. Like a kind of natural Noah's ark, these islands and their wild inhabitants—insect, bird, mammal and reptile—float about on the surface of the lake.

In other parts of the world, floating islands are also known. Such fragments of land sometimes drift down the Amazon, and travelers in South America have reported tropical lakes with wandering islands so large cattle could be pastured on them.

McKay first heard of unanchored, derelict islands when he was in the navy cruising to Australia on a battleship in 1926. It was almost a decade later before he saw his first land-raft drifting about on the surface of Orange Lake. For him, the odd, spectacular setting that these islands provide has never lost its interest or appeal. Exploring among them, watching the wildlife activity associated with them, showing visitors the beauty and strangeness of this natural-history wonderland, have become for Don McKay, at his one-man center, a life-work as well as a hobby.



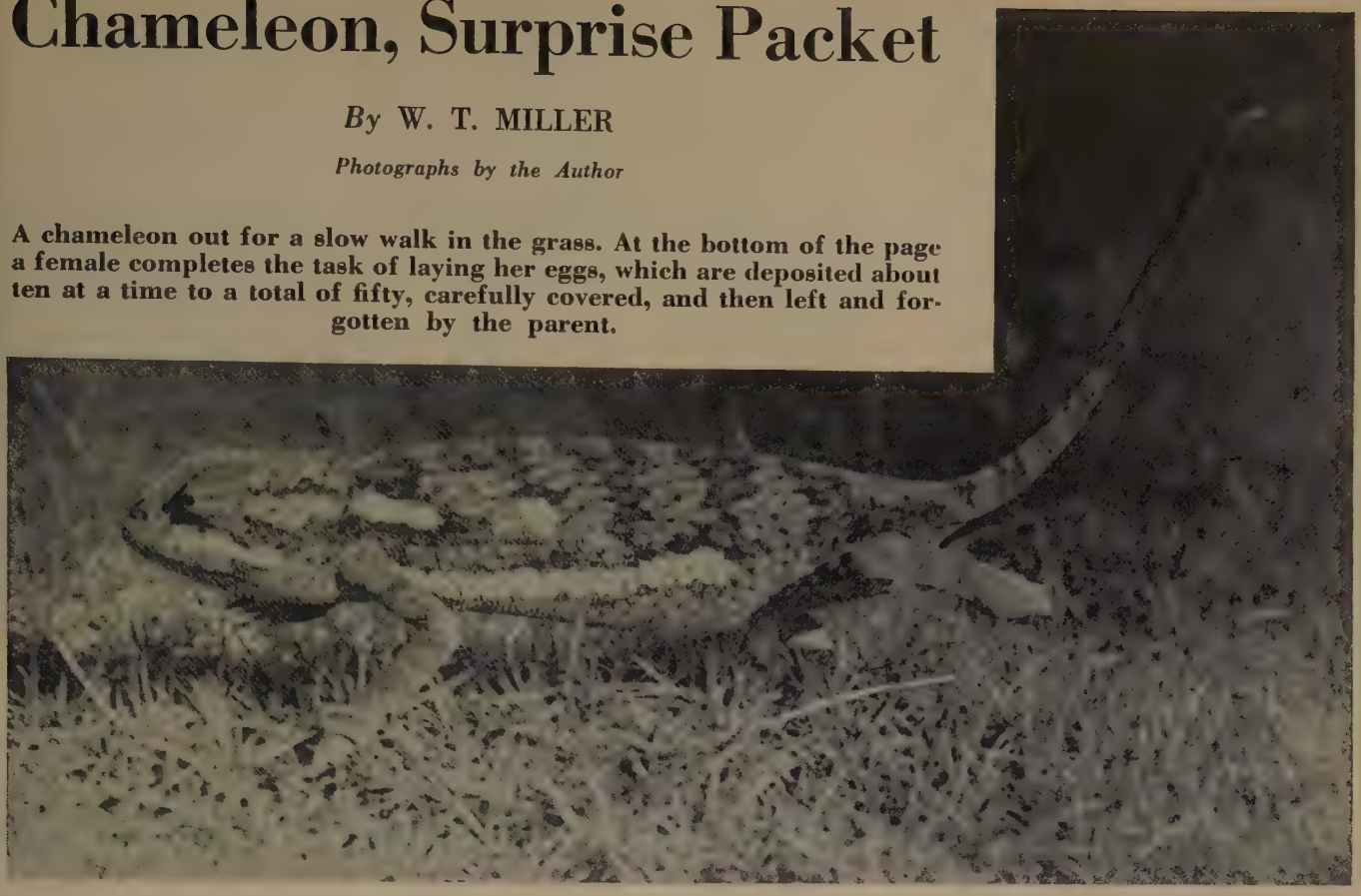
In the winter the floating islands tend to lose some of their buoyancy, sometimes sinking a foot or two below the surface. Trees as tall as eighteen feet have grown on some of the moving masses.

Chameleon, Surprise Packet

By W. T. MILLER

Photographs by the Author

A chameleon out for a slow walk in the grass. At the bottom of the page a female completes the task of laying her eggs, which are deposited about ten at a time to a total of fifty, carefully covered, and then left and forgotten by the parent.



THE chameleon is one of Nature's surprise packets. Its appearance is strange enough, but the unusual characteristics belonging to this one small reptile are stranger still. Indeed, its behavior has become almost legendary, and it is often credited with feats far beyond its real ability. Fantastic as the chameleon appears, each separate item of its makeup is of definite value.

It is a bush-dwelling and insect-eating lizard, and each peculiarity that a chameleon possesses is used either for success in capturing insects or for comfortable living in its arboreal habitat. Many lizards have taken to life in trees, but most of them dwell on the trunks and main branches. A chameleon, however, gets out among the slender twigs and leaves, where foothold is always precarious. Its exceptional feet are well suited for such situations. They are divided, like a T-piece, at the end of each leg, with five toes opposed to each other in groups of three and two. In effect the hindfeet are rather like a human hand if it had two thumbs and three fingers, while the forefeet have three thumbs and two fingers. Each digit

ends in a sharp, curved claw. Thus equipped, the chameleon can take a vice-like grip of the smaller branches, and is extremely difficult to dislodge. As an added safeguard, the animal curls its long, prehensile tail around the twig for extra anchorage. I have watched a roughly-shaken chameleon, although almost thrown down, hang with only the tip of its tail gripping a twig, then curl around and climb, hand over hand, up its own tail and back to safety.

Much of its time the chameleon spends without movement, except for an occasionally swivelling eye. With color patched and blotched to tone to the immediate background, with angular-jointed, thin, stick-like legs, and perfect stillness, it is guarded by a cloak of invisibility both from its own prey and those creatures that would prey on it. When it does move, the lizard advances with slow deliberation, taking several seconds to complete one step. At times the step is concealed by a to-and-fro rocking of the chameleon's whole body, like a leaf fluttering on the wind. By such tedious and stealthy progress the little reptile can stalk to within striking distance of the wary grasshopper, fly, or beetle that it hunts.

The uncommon protruding eyes of a chameleon are its most noticeable feature, and rather disturbing, since they work independently of each other. They are set in the tip of conical turrets. One eye may be directed upwards while the other looks down; one back, the other forward. But, when something edible is sighted, both eyes are slowly brought to bear on the insect so that its exact distance may be judged, ready for the lightning stab of the chameleon's unerring tongue.

With both eyes on the quarry the chameleon tenses its body. The loose skin under its lower jaw begins to swell. The broad mouth opens a little. Between the lips appears something like a ball of gray gum. Slowly this grows until almost half an inch is showing. Suddenly the whole club-shaped tongue shoots out like an elastic tube, six inches or more. The thick, sticky tip lands fairly on the prey. Then the rigid, stretched tongue collapses and is drawn back, carrying the insect into the hard jaws, which are equipped with compressed, triangular teeth. The chameleon chews for a mo-

The chameleon spots a juicy grasshopper, which will be seen at the upper right of the picture. Focussing its eyes on its prey, the lizard prepares for the strike that will bring food.

The chameleon's tongue is seen, above, just as it starts to protrude from the lizard's hard jaws. Below, the lizard's mouth opens wider and the tongue grows to about a half-inch in length.

Suddenly the whole club-shaped tongue shoots out to a length of six inches or more and the sticky tip lands on the prey.

The tongue has brought back the insect and the chameleon eats it, discarding hard parts. Below, the chameleon sheds its skin.

ment, ejects any hard parts such as wing-cases out of the side of its mouth, and is ready for more.

The greatest factor for success in still-hunting is ability to be absorbed by one's background. With its color-changing ability the chameleon has this, but do not credit this astonishing fellow with too wonderful powers. It never does *match* its background. Among green leaves it may be green, but a different green; on gray stone it may be gray, but a different gray. In darkness a chameleon turns pale primrose-yellow; in brilliant sunshine it turns black. This, when you think it out, is the correct tonal change for foliage, for the darkest greens are in the fullest light, while leaves in dark places are devitalized and pale. A chameleon crossing a tarred road, for instance, is bright green with a few small, yellow patches.

From minute to minute the chameleon's color is constantly being adjusted in response to the stimulus of light falling on sensitive skin cells and on the eyes. Within the skin of this remarkable animal there are four distinct layers of color. The lowest is the black layer, in which the black pigment, *melanin*, is contained in multi-branched cells. Between these pigment layers lie two of peculiar structure that give the effect of white and blue respectively. So there are layers of black, white, blue and yellow. The area of color in the black and yellow layers, being held in branched pigment cells, can be contracted almost to disappearing, or expanded so as to cover the whole surface. With this efficient mechanism the chameleon is enabled to approximate in a small degree the color and, in very great degree, the tone, of its surroundings. Not that the reptile uses any deliberate intelligence in the matter. The changes are entirely reflex, governed by the amount of light the skin and retina of the eyes receive. A blind chameleon loses much of its power of color change. Each area of skin, receiving a different amount of light, reacts by adopting a different tone or color, resulting in a mottled pattern that in itself is effective camouflage. To this also is due the curious phenomenon of two sides of the body being quite different in color, as for instance when the chameleon takes up a position at the edge of a dense shrub; so that one side

receives the direct sunlight and the other faces dark shadow. Among these color changes, combinations of green, brown, yellow, gray, salmon pink, black and white are almost endless. Some small areas also give spots of orange. But pure blue never appears.

While these color changes are for concealment only. there is a secondary type of change that serves an opposite purpose, that of display. These occur in emotional situations. At the period of mating, and in the presence of one of the opposite sex, a chameleon adopts a very dark, almost black, livery, variegated with yellow and green spots. At times of fright or anger, too, this dark color appears, while the throat becomes swollen and yellow. The chameleon inflates itself at his enemy with gaping mouth. This is a superb piece of bluff, since a chameleon is incapable of even giving a painful nip.

Like all lizards, the chameleon loses its skin altogether, occasionally. It gets sulky and goes into hiding. The outer skin turns white. Soon it cracks along the legs and shreds away, the chameleon helping by rubbing itself against twigs until the old coat is gone and the new bright skin exposed. This change, from beginning to end, takes about three days to complete.

While some species of chameleon produce their young ones alive—for example, the dwarf chameleon of South Africa—most of them, like the *Chameleon dilepis* shown in these pictures, lay eggs. They are usually laid in damp soil or rubbish. The female chameleon digs a hole by scraping the ground with the bony ridges of her head and pushing the loose material out with her splayed feet. The hole, five or six inches deep, takes maybe three hours to dig. Then the eggs are laid. These are half an inch long, with white parchment shells, deposited about ten at a time, each lot being covered separately with soil again. until perhaps fifty have been laid. Next the female pushes in the sides of the hole, fills up the hollow and presses the soil firm with her feet until the spot is completely hidden. It is a full day's work to get everything just right. Then she wanders off in search of food—for she has not eaten during this time—and forgets all about the eggs. They will hatch on their own in from three to eight months, depending upon warmth. The leathery shells turn soft and wet, so that the tiny chameleons, an inch long and bright green in color, can break out and scratch their way up through the soil.

African natives in every part of the continent have a strong dislike, even fear, of the quaint chameleon. One of their folk stories explains it this way. At the beginning of the world the Creator chose the chameleon as his messenger to carry to men the promise that they should not die. The chameleon—who in Zulu is called "Hamba Gahle," Go Slowly—went along at his deliberate slow pace, and in the meantime the Creator sent another messenger, a swift-running lizard with a new command: "Men must die." The lizard arrived first and men accepted his message. So they blame death on the tardy chameleon, and hate it.

Nature, Pro and Con

By MABEL IRENE HUGGINS

In the following list are represented some of the pros and cons of Nature. Specimens from the plant, animal, and mineral kingdoms will be found, as well as some important parts of certain animals and plants. Simply fill in the blanks using as clues the definitions that are given. Turn to page 108 for the answers. Count 5 points for each that you have correct.

1. Pro_____	An antelope-like animal of the western United States and Mexico.
2. Con_	A rabbit.
3. Pro_____	Minute, one-celled animals. mostly aquatic.
4. Con__	A kind of shell.
5. _pro__	A shoot from a seed.
6. Con___	A large American vulture.
7. __pro__	An important part of certain plants and trees.
8. ___con	A kind of hawk.
9. Pro_____	The trunk of an elephant.
10. ___con	A mineral used as a gem stone.
11. --pro--	The corn poppy.
12. Con____	A cone-bearing tree.
13. Pro_____	The genus consisting of the conies.
14. _con___	The monkshood.
15. Pro___	A kind of swallow
16. Con___	A kind of eel.
17. Pro__	Millet.
18. Con_____	The bindweed.
19. _pro__	The name for the house sparrow in certain areas.
20. Con_____	The star-nosed mole.

The Woodland Jumper

By LLOYD SCHERER, JR.

Illustrated by Jackson Miles Abbott

The woodland jumping mouse must keep a wary eye for his enemies, including owls, but its habits in the wild are good protection. Below, the colorful and interesting little animal, seldom seen, clings to grass stems, balancing with its long, white-tipped tail.

THE word "mouse" creates widely varying impressions on the minds of different people. To some it provokes instant visions of a tiny, gray-furred and somewhat repulsive creature that raids pantries; while to the woodsman it signifies the dainty, fawn-backed deer mouse that etches tiny trails on the snow; and the farmer recalls the short-tailed meadow mouse of his fields.

Few persons, however, associate the word with an animal like the colorful, absurdly long-legged, woodland jumping mouse. Indeed, very few know that such a mouse exists. And only the woodland jumper himself is responsible for the obscurity of his life. His kangaroo-like form and exquisite hues command attention anywhere. But, although he abounds in many localities of the northern United States and adjacent Canada, east of the Great Plains, he dwells in such seclusion that his presence usually remains unsuspected by everyone except the family cat.

The jumper's overly developed hind limbs, terminating in long, rear feet and spreading toes, and balanced by a slender, long, lightly-haired tail with a narrow white brush at the tip, preserve him well from threatening enemies when he chooses to vault into the air.

His coat could outrival many a bright songbird. The broad band of dark brown fur extending from the top of his head over the full length of his back borders bright orange on each side, which underneath gives way to pristine white sometimes suffused with a thin, rose wash.

These characteristics might seem to elevate him from the mouse class. But his dark, inquisitive eyes; pointed, whiskered snout, and short, rounded ears remind us that he is, after all, only a glorified mouse.

To find this little recluse we must investigate the borders of lively forest streams or gurgling spring runs. Inasmuch as jumpers seldom roam except in darkness, the quickest and surest way of discovering them is to set a dozen or so nut-baited, non-injuring mousetraps on any little runways that we can find on, or under, the moist forest debris.

If you are lucky enough to capture one, and you show it around afterwards, I will guarantee that you will meet few, if any, people who are not surprised to the point of incredulity at beholding such a strange and handsome mouse from their own neighborhood.

Once having made the acquaintance of this striking little animal, you can often detect his activity in new places by his distinctive tracks. In the fine silt of stream borders, or the muddy ruts of woods roads, look for prints that exhibit five slim toes spreading from a single point, like a bird's, contrasting to the chipmunk's five nearly parallel toes extending forward from a broad foot pad. No other mouse in his domain has a track so large, nor so birdlike, as the woodland jumper.

Once you have found the track, your only possibility of confusion is with the meadow jumping mouse. It is a species slightly smaller than the woodland variety. less brightly colored, lacking the white tip on its long tail, and inhabiting damp meadows that are usually quite apart from our woodland jumper's haunts.

In the few rare instances when I have glimpsed the woodland jumper abroad during daylight, he always streaked away in quick, blurring leaps, reminding me of a super frog. However, despite his long leaps—ten feet and more—in which his long tail serves as a rudder to keep him from tumbling end over end, he more commonly achieves his getaways by fast, zigzagging, short hops—about two

feet—that would thoroughly confuse any but the most dexterous pursuer. He keeps a vigilant eye for owls, weasels, foxes, cats and snakes.

Once, I am proud to relate, I caught a jumper in my bare hands. I had been wanting one alive, and, startling him from the level floor of a small gully, where little vegetation grew, I dived after him. For a few moments we had a wild time, the nimble mouse bounding this way and that, with me half a leap behind. Finally, at the end of one of his leaps, he hesitated just a second too long and I threw my cupped hands over him.

I touched him scarcely at all—nothing to cause any bodily injury—but nevertheless he was securely imprisoned! After waiting a moment, during which time he did not move, I closed my hands slowly, gently beneath him—except for his long tail which hung outside. Still he remained motionless, so I lifted him and opened my hands, a little at a time, and watched. But he made no break to escape. He did not even sit up. I leveled my palms, and still he lay there . . . dead!

I could not understand it, for I found not a single mark on his body, not even that evening when skinning him to prepare a museum study skin. I could conclude only that I had scared him to death.

The jumper's home is a nest in a snug, dry nook beneath some stump, log or other shelter. And there, during midsummer, each pair of the unique animals presents to the world its three to six long-legged little ones.

As a rule they produce only a single litter in the year—an unusually low reproductive rate for mice. But it suffices, because the jumpers, in addition to their superb leaping ability, have another and even better device to preserve them from the heavy predation that falls on most wild mice.

This defense is their hibernation. When nearly all other species of mice, in the manner of chipmunks and squirrels, are garnering winter supplies, the jumper makes no such slave of himself, and continues to lead an easy life. He stuffs his stomach daily with the various little edibles of the woods: berries and tiny fruits of many kinds, seeds, buds, spiders, small caterpillars and various insects. When the summer reaches its end he has accumulated, not a hoard of food, but a thick layer of fat, like a bear.

He is a far more profound hibernator than the bear. The first nippy fall weather, while food is still abundant, drives him permanently to his nest, where he curls into a tight ball, tail wound around the outside. There he sinks not only into a deep sleep like the bear, but into that deathlike torpor, which is the only true hibernation. His tiny heart, ordinarily beating at a rapid rate, now slows to almost imperceptible motion. His body temperature drops to that of his surroundings, sometimes only a few degrees above freezing. And from that time on his stored energy is consumed very, very slowly.

For six long months he remains to all appearances dead, never seeing the snow that piles above him, nor feeling the sting of a blizzard. Half of the year is a long time to retreat from the world. But to the jumper it doubtless goes quickly. And in the renewed warmth of springtime he returns to a land that has once more become hospitable with food and cover.

☆

Maine Wood Magic

By PHILLIP O'DONNELL

[This poem was written by an enrollee in the Civilian Conservation Corps of the early thirties and published in the book *This New America* by Alfred C. Oliver, Jr., and Harold M. Dudley. Mr. Dudley called the poem to our attention, feeling that it is worthy of wider reading than the book affords. We most heartily agree.]

Blest be the woods and they that dwell therein;
Balsam and birch, Dear Lord, our woods and Thine,
Blest be their bubbling springs, their rippled lakes,
Their ponds, and every laughing brook that makes
Rainbows and foam and crystal homes for trout.
Blest be the trails that wander in and out
Among gray boulders drowned in soft green seas
Of velvet moss; oh, blest be all of these.

Blest be the woods and they that dwell therein;
The scolding squirrel and his gentler kin;
The friendly chipmunk and the timid hare;
Blest be the graceful mink, the shambling bear,
The beaver on the dam, the drumming grouse;
The hawk that loves the sky, the white-foot mouse;
The antlered buck that paces proud and tall,
With doe and dappled fawn, blest be they all.

Lord bless the woods for perfect loveliness;
For balm that heals the soul in care and stress.
Keep them forever fragrant, cool and sweet;
From thunderbolt and flame, from gale and sleet,
From avalanche, from tempest, drought and blight,
From all that is unclean, from ruthless might
That gives to desolation, valley, glen and
Mountainside. God bless our woods, Amen.

The least pygmy shrew, the smallest mammal in North America, and, probably, in the world, is about twice the size of a cricket and weighs less than a nickel.

North America's Smallest Mammal

By ROMEO MANSUETTI

THE least pygmy shrew, the smallest mammal in North America, and possibly in the world, was first found wild only a few miles from the nation's capital. Indeed, it represents one of the most spectacular discoveries made by naturalists and biologists in the vicinity of the District of Columbia during the past century.

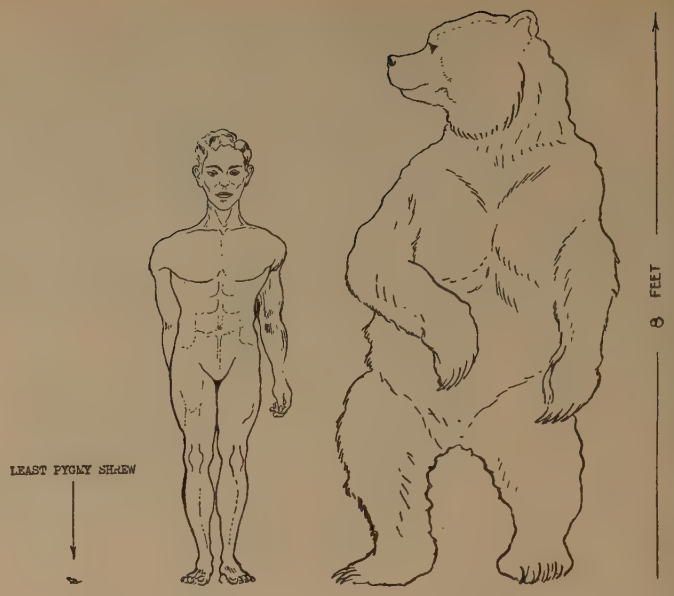
Had it not been for a Nature stroll, one April day in 1903, by Edward A. Preble, veteran ornithologist and mammalogist, then of the Bureau of Biological Survey and now associate editor of *Nature Magazine*. the tiny mammal might still be unknown. He discovered one alive on the bank of the Potomac River while accompanying friends on a field trip. Needless to say the capture of the creature was a surprise among the local naturalists. Why the small beast had not been found before by the many mammalogists who had systematically trapped for specimens in the District of Columbia region was a mystery.

Rare as it is, few people ever see this tiny shrew, or are capable of identifying it. While collecting salamanders, Mr. Preble uncovered the mammal from the decayed interior of a large fallen log. Thrilled at finding a shrew so diminutive, the zoologist at first considered it to be a young one of the common local long-tailed shrew. After carefully preserving and examining it, however, the naturalist found that it belonged to the genus of tiny shrews known as *Microsorex;* later he described the animal, characterized by peculiar tooth pattern and general proportions, as *Microsorex winnemana.* When the new form was thus formally described, only one additional specimen of this race had appeared, and the genus had not been recorded south of Ohio and New York. The author also noted that, early in 1857, Spencer Fullerton Baird, the Smithsonian Institution's great zoologist, had described the first *Microsorex* from Wisconsin.

Roman-nosed, with tiny, piercing black eyes, this little insectivore is only about twice the size of a cricket. Like most small shrews, it is attired in gray. the upper parts being grayish-brown while the lower parts are ashy-gray. Whether the summer and winter pelages differ in the District of Columbia region is not known because of its rarity in collections. A slender and delicate species, it is easily recognized by experts by its small size and tiny feet.

Despite the great amount of research within its range since its discovery, the least pygmy shrew still

The least pygmy shrew is about the size of man's little toe, and weighs about one-ninth of an ounce. When compared with the Alaska brown bear, North America's largest land mammal, and man, the little animal is puny indeed.



remains a very rare animal. It has been found only on eight known occasions in the area from southern Maryland to southwestern North Carolina. Over the whole eastern North American range of the genus, where some forms are more at home in the northern forests, relatives of the least pygmy shrew are only occasionally encountered. Strangely enough, amateur naturalists and laymen account for most discoveries.

When Preble measured the first least pygmy shrew, he was amazed to find that it was a little more than three inches long, of which length the tail comprised about a third. What was more interesting was the fact that its elongated body, including its pointed snout, was less than one-half inch in diameter, making it the flyweight of the Lilliputian mammal world. The average shrew weighs less than a nickel.

The least pygmy shrew is a veritable sprite of the woodland, prowling and tunneling among dead leaves, forest humus and in rotten logs. Owing to its secretive habits, it cannot be studied in its environment, although it may be as bold as its distant cousin, the short-tailed shrew. Anyone who captures a specimen can consider himself extremely fortunate. It is not surprising that hardly anything is known about its habits, life history and pelage variation. As in the case of many other rare species, generalizations concerning it are based on the habits of close relatives.

Why the least pygmy shrew is so rare is a deep mystery. Within its home area it probably has a very limited distribution, controlled by its environment or habits, such as vegetation, soil features, food, moisture and other factors. Thus it is probable that it occurs only in isolated areas over its range. On the other hand, its numbers may be controlled by cycles, a normal phenomenon among rare species. Whether any one type of environment is favorable or not has not been determined, but it seems to prefer boggy, deciduous areas, swales, and areas near meadows.

In accordance with the laws of Nature, snakes, owls, hawks, weasels, and other carnivorous animals prey upon the least pygmy shrew, and these enemies doubtless account for many individuals. It has been observed to make burrows small enough to preclude most snakes and weasels.

The proverbial "taming of the shrew" is not literally applicable to our tiny North American representatives. The frail appearance of shrews is deceiving. In reality they are savage and aggressive enough to fight, and often overpower adversaries many times their size and weight. When grasped, the pygmy shrew would probably bite fiercely with its sharp teeth. As a secondary protective measure, it has been recorded to exude a musky secretion from well-developed glands. These glands, no doubt, serve also as methods of recognition during courtship.

This shrew has eluded most diligent investigation in recent years. Efforts by trained mammalogists to obtain additional data on it in and around the Patuxent Research Refuge in Maryland have not been successful. All data available on its habits have been utilized in approaching the problem of capturing additional specimens and gathering information about it, with meager success. The second specimen ever captured, however, was discovered not far from the Refuge in the decayed heart of a dead chestnut tree on a dry hillside not far from water.

Nothing is known of the least pygmy shrew's feeding habits, but it is probably as insectivorous as its brethren. Besides, it probably feeds on spiders and earthworms. All shrews are more or less active in both winter and summer, and many of them hunt insects in broad daylight for short periods, scrambling underground at the slightest disturbance. Breeding possibly takes place in spring and summer, and several litters, of from three to seven young, may be born each season.

Preble's initial declaration—"*Microsorex winnemana* is the smallest species of shrew (and therefore the smallest mammal) thus far discovered in America"—has never been challenged. The next smallest mammal in North America is probably the Maryland long-tailed shrew. Compared with the Alaska brown bear, the largest land mammal in North America (weighing up to 1650 pounds), the least pygmy shrew is certainly insignificant.

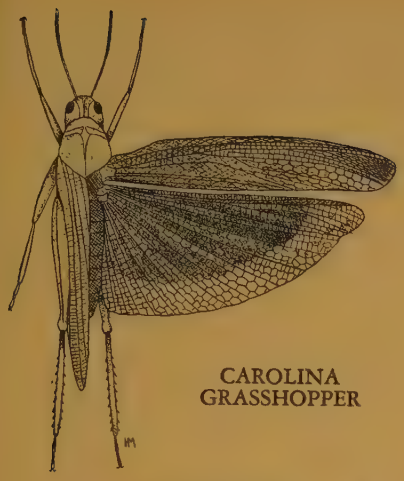
In the original description of the least pygmy shrew, Mr. Preble states: "The specific name *winnemana* (beautiful island) is in allusion to Plummer Island, the home of the Washington Biologists' Field Club, near which the type specimen was taken."

The situation confronting naturalists today is how to obtain more data about a creature that has so far been trapped so rarely; observed alive so few times.

Grasshoppers and Their Kin

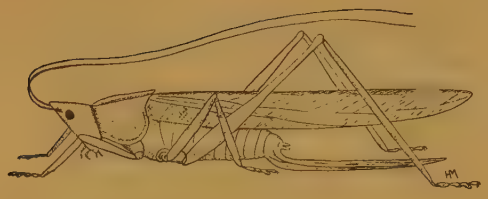
By
E. LAURENCE PALMER
Illustrated by Heinz Meng

This is the forty-eighth in Nature Magazine's series of educational inserts.



CAROLINA GRASSHOPPER

LESSER MIGRATORY LOCUST



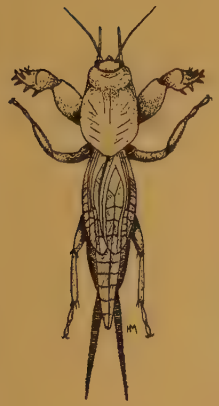
ROBUST CONE-HEADED GRASSHOPPER, AND, BELOW, TWO-STRIPED GRASSHOPPER

MEADOW CONE-HEADED GRASSHOPPER

IT may seem strange to offer an insert on grasshoppers at this time of year. It is the fall and late summer when they reach their greatest abundance, and it is then that the air is filled with their music. But when we broaden our subject—as we have—to include the kin of grasshoppers, there is no time of year when we cannot study them.

WOOD ROACH

Cockroaches roam at will throughout the year in some homes. Wood roaches can be found under the rotting bark of trees even in winter. And in regions where praying mantes are in abundance, children bring their egg cases into the house and then wonder what they can do to feed the young mantids that hatch in the warmth of the house, only to have to eat each other or starve. It is in the spring that home gardeners, looking for something to buy to help their gardens, buy mantis egg masses, thinking that a few of these judiciously placed will make it unnecessary to fight the bugs later in the season. A professor friend of mine does this regularly, and, I am sure, without the slightest effect on his garden problems.



MOLE CRICKET

But what *are* the orthoptera, to which all of these insects belong? Any one who has been through a high school course in biology has, no doubt, drawn a pickled grasshopper. He has examined the chewing mouth parts and labelled the parts of the parts. He has learned, probably, that the critters have incomplete metamorphoses, which means that the little grasshoppers show a striking resemblance to their parents when they hatch from the egg, and do not follow the egg, larva, pupa, and adult plan as do butterflies and some other insects. The student may even have studied the internal workings of a grasshopper and has wondered at what he found. The first time I did this my specimen was well filled with a large parasitic worm that did not look at all like what the picture in the book had indicated was to be found in the insect. My teacher, an English teacher, was equally stumped and told me to forget what I found and copy what I found in the book. It did not make sense to me, but I respected the authority under which I worked.

CROTON BUG

However, grasshoppers and their kin in a classroom jar of preservative, and the live, free animals, are quite different objects of study. One is disgusting to some of us, while the other is intensely interesting. In the order orthoptera, those species that have wings as adults have the wing covers straight or orthodox. This is where the group gets its name. But some have no wings, and yet, because of their general obvious relationships, they are still placed in our group. In this group, in fact, is a tremendous variety of insects. There are the primitive cockroaches, which are probably very much like their ancestors that roamed the earth as early as the Jurassic times, in the middle of the Age of Reptiles. There are the gro-

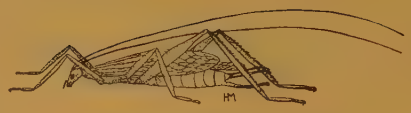
WALKING STICK

tesque walking sticks, praying mantes and leaf insects, the leaping grasshoppers, and the burrowing mole crickets. There are katydids and walking sticks that live in the tree tops, roadside grasshoppers that frequent the dusty roads, meadow grasshoppers that haunt the grass jungles, cave crickets that live in dark, cool, damp spots. They leap, crawl, run, fly and burrow, and there is probably no place outdoors where man himself works or plays, or indoors where he lives, that some orthopterans do not offer some claim to the same territory. They are meek or aggressive, noiseless or loud, harmful or useful, amusing or disgusting, hardy or sensitive, active night or day, in drought or flood, in winter or in summer. It is quite a different thing to know an insect case of dead orthopterans and to know the life habits of any one kind.

In the chart section accompanying this article we have given some details of the life history of a number of orthopterans. Ordinarily, we have accepted as typical a life history such as we give for the lesser migratory locust, but this pattern cannot be applied to all members of the group with any safety. Those who might wish to get good notes on the love life of many members of this group should read Fabre's *The Life of the Grasshopper.* Few writers have presented with greater skill, humor and probable accuracy the story of these insects' behavior. His account of the trials and tribulations of a male praying mantis seeking favor with a prospective mate is a masterpiece. It has been presented in greater detail, possibly, by Wheeler in his *Foibles of Insects and of Men,* but without Fabre's artistry.

Of course, when we speak of the mating instinct in animals, we are often likely to accept anthropomorphic explanations of what we see. Frank Lutz exploded beautifully the idea that crickets sang to win favor with the opposite sex. By the simple expedient of placing males and females so that they could or could not see each other, he found that it is obvious that the sounds are, as they are probably in birds, really challenges to other members of the same sex. Lutz' amazingly simple experiment upset completely much that had before been accepted as fact. Anyone can make a little box, an inch on a side, of screen wire and in it confine a sound-making orthopteran and learn much himself.

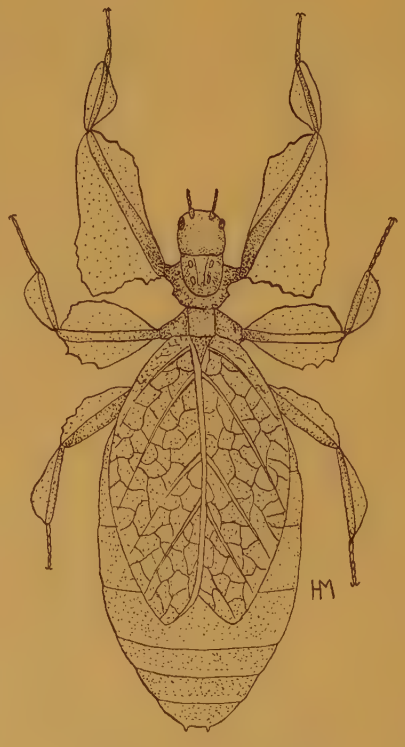
In some parts of the world, of course, orthopterans are kept in confinement for reasons other than study. In some places, they are kept merely for the sake of listening to them sing. In others, they are kept to be used in contests with others of their kind for the sake of having something on which to bet. One friend of mine, a number of years ago, earned his doctor's degree by feeding cockroaches that he kept in small cages and observed the effect of different diets on the experimental animals. He found that, for the purpose of studying some kinds of diets, the cockroaches are ideal laboratory animals.



SNOWY TREE CRICKET

FIELD CRICKET

PRAYING MANTIS



TROPICAL LEAF INSECT

But let us not forget this sound-producing ability of some grasshoppers and their kin. The sounds are not produced by vocal organs as is the case in many other animals. Rather, they are produced by what the zoologists prefer to call stridulating organs. These may be on the legs, wings, or on other parts. While an insect without wings cannot fly, we cannot assume that because some grasshoppers make noises with their wings that wingless relatives must be noiseless. The Jerusalem cricket of the West makes its sounds, apparently, by rubbing its third pair of legs against the abdomen. The resultant sound is like that of rubbing sandpaper, but it, no doubt, serves a purpose somewhat similar to that attained by other means with most of the orthopterans.

The hearing organs are variously placed in the different grasshoppers and their kin. In some cases, the receivers are on the legs. In others they may be on the abdomen. The pitch of the sounds varies from the relatively low sounds produced by some of the katydids to sounds produced by many of their relatives that are beyond the pitch audible to most of us. Dr. Allen and Dr. Kellogg, who have given us such fine records of the sounds produced by birds and amphibia, will, we hope, some day offer us equally attractive records of the sounds made by insects. They already have some recordings in this field that should be generally available. When that time comes, then we can all sit down in front of our phonograph and learn to distinguish at least a few of the characteristic sounds of these insects. It is easy to recognize the katydids' oft-repeated "katy-did-she-did." It is equally easy to learn the rhythmic chorus caused by great numbers of snowy tree crickets calling in unison. These sounds are as typical of late summer and early fall as peepers are of the spring, and bullfrogs of the summer.

While it is easy to learn to recognize the sounds produced by a few kinds of crickets, grasshoppers and their kin, it is

not always so easy to learn how to locate the singer. Dr. Lutz used to use the simple triangulation method. He would line up his students in a straight line and get them all to point to where they thought the sound came from. While some would be unable to do much satisfactory orientation, usually the sum total of the judgments would be significant. Once a general area had been agreed upon, the group would move towards the center and repeat the pointing technique. Eventually, the singer would be located. I well remember doing this with him one moonlight night when we could just see each other in the field. When we had finally agreed as to about where the insect was, we formed a circle, and, at a signal, all turned our flashlights on the spot we thought most promising. Sure enough, there on a low shrub was a stridulating katydid that we never in the world would have found by individual effort.

JERUSALEM CRICKET

BROAD-WINGED KATYDID

CAVE CRICKET

FIELD CRICKET

MEADOW GRASSHOPPER

The different insects of this group vary greatly in the amount of light that induces activity and the temperature at which they are most active. Here is a whole field in which little has been done that is really satisfactory. In the fourth section of our tabulated material, we have given some clue to some of the findings. Reading this material over, you will find that some are at their best in bright sunshine, some on cloudy days, and, of course, many on the darkest night.

Lutz, again experimenting with cockroaches in this group, once learned that they are sensitive to different parts of the light spectrum than are we. With this information, he went to work and got cockroaches to be active in what, to them, was darkness but, to us, was some sort of light. This made it possible for him to get cockroaches to come out into his museum case and perform for visitors who otherwise would have been able to see no activity whatever. These experiments of his were characteristic of the man, and make many of us wish that there could be many more like him investigating the commonplace things of Nature, and finding new and perfectly rational conclusions that contradict what may have been accepted as wholly valid for an indefinite period. His little rule of trying to find the significance of changing the smallest factor that influenced an animal never seemed to get into the classroom program where it should have yielded remarkable results.

Man judges most of his associated animals largely by how they compete with his own selfish interests. Orthopterans, for the most part, are serious competitors with man's interests. The great scourges of "locusts" that have wiped out man's food supply and contributed to famines are standard incidents in the history of almost any country. We find it recorded in Biblical times. The Mormons faced the issue with prayer, and got an answer from the gulls, to whom they erected a monument in Salt Lake City. Locusts provide a spectacular incident in Pearl Buck's *The Good Earth,* her story of the trials and tribulations of survival in China. Fortunately, these scourges have, to a considerable extent, been lessened by reasonably sound agricultural practices, but whether this was due to intelligent planning or to luck is a matter of one's judgment of the reasoning.

We find in many cases in history that man has turned the tables on the grasshopper pests, and has, in some cases, even sought their appearance in overwhelming numbers. This is among peoples who have learned to use the insects themselves as food. Margaret W. Morley in her intriguing little book, *Grasshopper Land,* has given us as readable a summary of the use man has made of these animals for food as is to be found anywhere. She even goes into the details of preparing the animals by boiling them in oil, of drying them, of grinding them and of making them into cakes and other delicacies. I fail to find where she speaks from personal experience as to how they taste, although she does say that they "should taste" as good as prawns, shrimps and similar animals. One wonders whether she had the courage of her convictions.

During the recent war, many men in our armed forces were given some suggestions as to how these relatively abundant animals could be used, at least as survival food. I have heard of no wholesale effort to make the animals popular as an early morning appetizer. There is no doubt but that man could turn an abundance of grasshoppers into some value by drying them and preserving them for use as food for poultry and for fish.

Of course, any animal so universally abundant and spectacular in behavior as the grasshopper must now and then creep into the folklore of a people. In such cases, it is not uncommon for the stories to increase in their bizarre qualities as they are handed down from one generation to another. Pliny, for example, reports, from India, grasshoppers more than three feet long with legs so strong that women used them for saws. Swedish boys, and boys of other lands, for that matter, are reported to use the "spit" of grasshoppers to drive away warts, and in many parts of the world the mass attacks of great numbers of insects are reputed to be directed by (*Continued on last page of insert*)

FAMILY	BLATTIDAE		MANTIDAE	PHASMIDAE
SUBFAMILY	Blattinae	Panesthinae	Mantinae	Racunculinae
COMMON NAME	Croton-bug. German Cockroach	Wood Roach. Brown Wingless Roach	Praying Mantis European Mantis	Common Walking-stick
SCIENTIFIC NAME	*Blattella germanica*	*Cryptocercus punctulatus*	*Mantis religiosa*	*Diapheromera femorata*
DESCRIPTION	Length, including antennae: nearly 2 inches; body, about ½ inch. Brown, with 2, rather wide, black lines behind the antennae to near the base of the wings. Wings when folded are about ⅔ the length of the animal minus the antennae. Body: smaller than in male wood-roach or in American cockroach.	Length of body: slightly over 1 inch. Male and female: practically identical, externally. Dark, chestnut brown, shining, with antennae and legs, reddish brown, and margins of the body somewhat paler than the back. Eyes are concealed and the face is finely and sparsely dotted as are the dorsal segments.	Length: about 2 inches. Green or brown. Forelegs: used in grasping prey and held as though in prayer, with forward part of body bent upward and head twisting from side to side. Antennae: erect and short. Hind legs: used in walking and in leaping. Four well developed wings permit slow, extended flight.	Length, overall: to 4 inches, or more, with diameter of body only about ⅛ inch at most. Six legs are in widely separated pairs, and may be held so that animal resembles a green or a dead stick, since color may be green or brown. Legs and antennae: about equal in length. Eyes: small and to front.
WHERE FOUND	Native of Asia but made their way hence into Europe and thence into America coming to special attention in New York about the time water from the Croton dam came into use in New York, hence the name Croton-bug. It is now found over most of the world, spreading and being introduced by ships largely.	In mountainous and hilly country, from New York to Georgia and west to Kentucky; also on the West Coast, from Washington through Oregon to California. Usually, found just under the bark of soggy logs from which the bark may be easily stripped. There is but the one genus to be found in this country.	European Mantis is native of Europe, well established in eastern United States. Known as rear-horses, mule-killers, devil-horses and soothsayers. Native smaller mantis of eastern United States is *Stagmomantis carolina*. About 20 species in the country. Chinese Mantis, *Paratenodera sinensis* has established itself in the eastern states.	Relatively common in United States, except in more southern states. About 20 species found in country and group is mainly tropical, where it is represented by over 600 species, some over 16 inches long and one the famous tropical leaf-insect, *Phyllium scythe*.
REPRODUCTION	Instead of laying her eggs in cracks and crannies as does the American cockroach, the female of this species carries them in a small capsule attached to the rear of her body. From these, emerge the young cockroaches that closely resemble the adults. In some species, it may take a year to complete the life cycle while other cockroaches do this in much less time.	Information regarding the life history and general reproductive habits does not seem to be easily accessible. It is probably in general similar to that of the related cockroaches discussed in the preceding column.	Large, straw-colored egg masses of to 1000 eggs are laid on boards, weeds or buildings in fall. They normally hatch in May or June into little mantids that resemble the parents except for size and absence of fully developed wings. Young grow slowly acquiring wings and maturity about August. Egg masses: often an inch long may be hatched indoors but if so young may starve.	Eggs: white, with a black stripe, dropped to ground from trees in fall, sounding like rain, hatch in spring. Young: resemble adults in shape, but not in size. Full size may be attained in 6 weeks after hatching. In some species, eggs do not hatch until the second spring after they are laid.
HABITS	Cockroaches avoid light and favor moisture. They feed upon any suitable organic matter discharging what they may have eaten to make room for further feeding. They may eat filth, good food, book bindings and even the parts of living animals and serve in the spread of disease through the contamination of food stuffs as well as through the destruction of valuable food.	Food is probably soft, soggy, decaying sapwood in which the animals can and do burrow. In North Carolina and Virginia, they are most frequently reported in decaying chestnut and pine while in Oregon it is reported most completely from decaying fir logs.	Food: largely flies, grasshoppers and other insects. Female frequently eats her smaller mate after the breeding act or even before if her hunger exceeds her romantic feelings. Prey is grasped and held by spine-laden forelegs, eaten at leisure with most comical display of indifference.	Food: largely foliage of trees of the forest. Sometimes destruction of leaves is complete and hence serious. Activity greatest at night. No noises are made. Since there are no wings, locomotion is by walking, though some species leap and others run. Individuals may remain practically motionless during daylight.
ECONOMIC IMPORTANCE	These are serious enemies to health. The newer insecticides such as DDT have been effective in keeping the animals under some control and where these may be used safely they should be used generously and constantly. At the first sign of an infestation, prompt action should be taken to eliminate them.	It is probably not of economic importance and while it may be found about camps it is not likely to become a serious household pest under any circumstances. Because of this, no control measures are probably necessary.	All exceptionally useful destroyers of other insects and should be encouraged in gardens where they may play an important role in insect control. Larger species widely introduced. Egg masses are collected and sold for establishment of colonies. Read Fabre's description in "The Life of the Grasshopper."	May be serious pests to trees. Are entirely harmless to man himself. When abundant as pests, they are sometimes controlled by use of a sprayed stomach poison. Food is chewed, not sucked. Superficially resemble water scorpions of freshwater ponds (See insert #1), but these suck their food rather than chew it.

PHASMIDAE	ACRIDIDAE			TETTIGONIIDAE
	Oedipodinae	Locustinae		Phaneropterinae
Tropical Leaf Insect	Carolina Grasshopper	Lesser Migratory Locust	Two-striped Grasshopper	Forked-Tail Bush Katydid
Phyllium scythe	*Dissosteira carolina*	*Melanoplus mexicanus*	*Melanoplus brevittatus*	*Scudderia furcata*
A group of exotic insects varying in size to some inches long. Expansions of the legs and of the back have a close resemblance to leaves on which the animals live even to the imitation of veins that may be found in leaves. Since the movements are slow, the insects easily escape detection by their enemies.	Length: to 2 inches. Dull, grayish brown, with inner black wings margined conspicuously with yellow. With some dark clouding in the body color but usually appears to be unspotted and generally dust-colored. Wings extend from ¼ to 1/3 their length beyond end of abdomen. Jumping legs well developed.	Length: about 1 inch. Yellow or tan, with dark bars across hind legs. Fore-wings: grayish, extending beyond the end of the body, with a few dark spots near the middle. Female: with end of abdomen as shown in figure. Antennae: relatively short. Hind legs: suitable for jumping great distances, even without help of the wings.	Length: 1½ to 1¾ inches. With yellow stripes extending along the back from the compound eyes almost to the tips of the folded wings but united near the middle of the wings. Antennae: relatively short, straight and forward directed. Body and abdomen: plump and whole animal substantial.	Length: about 2 inches, overall. Fore-wings: nearly uniform in breadth through length, differing in this respect from angular-winged katydid, *Microcentrum* that has a short, abruptly up-curving ovipositor, and the oblong-winged and round-winged katydids *Amblycorypha,* that have long, curved ovipositors.
Members of this genus are native of the tropical parts of the Old World, but our nearest native relatives are the walking sticks that resemble twigs rather than leaves, both belonging to the family Phasmidae. Members of this family almost invariably get protection through mimicry of the parts of the environment in which they live.	Found practically throughout the United States appearing most frequently along dry, dusty roadsides or in relatively barren spots. There are 6 species of the genus known to be found in the United States of which this may be the best known though not necessarily the most common.	Wide distribution in North America. Found in fields and meadows. Often serious pest in the East. Commonly found with red-legged grasshopper. *M. femur-rubrum.* Rocky Mountain grasshopper formerly known as *M. spretus* is merely long-winged migratory phase of *M. mexicanus* which until recently was known as *M. atlanis.*	Found throughout the United States except in the south Atlantic states, in fields, on crops, or in a great variety of places. The related *Melanoplus spretus* or migratory Rocky Mountain locust migrates east from the Rocky Mountain area in great flocks destroying all plants in their way.	*Scudderia* in different species, is found throughout the United States and most of Canada, but mostly east of the Great Plains, living on bushes. True katydid, *Pterophylla,* is found in trees, usually in restricted colonies, but throughout United States, east of Rockies.
Notes on the reproductive habits are not available but the story is probably much like that to be found in the walking sticks discussed in an adjacent column.	Male may hover in air over female in apparent courtship behavior making a purring or beating sound with males sometimes apparently competing vigorously with rivals or actually fighting. There may be 2 broods a year with adults being found in the North from June through November and mated individuals appearing by first of July.	Mates, and in fall, female lays eggs in burrow underground, in clusters of 12 to 80, in 2-inch burrows. Eggs: about 3/16 inch long, like taper-ended cylinders; hatch in spring into nymphs that shed skins 5 times before attaining maturity and wings. No pupal stage.	Egg: placed in a pit about 1 inch deep, in clusters of 25 to 80 and covered with a fluid that hardens forming a pod. One female may lay a number of pods. Unless disturbed by plowing or other means, eggs hatch in spring and in about 3 months young grasshoppers can reach maturity and breed.	*Scudderia* lays flat eggs, 1/3 to ¼ inch long, in rows on leaves, in late summer. These hatch in following season and young resemble adults, except for absence of wings. There is of course no pupal stage.
Food: largely plant materials among which the insects are found. Food is chewed. Animals are harmless to others though they may possibly serve as food for species clever enough to recognize them as eatable.	Wings are used extensively in travels, the flight being usually noiseless, zigzag and rather well maintained for some distance. Hind legs are powerful enough to give the insect a good initial start. Animals are somewhat social and when excited tend to fly to bare open areas rather than to dense cover as do many other grasshoppers.	Food: almost any plant material, often serious pests to crops. Some grasshoppers give weak sounds. The Carolina locust of the roadside displays yellow-bordered, black, hind-wings and the cracker locust gives a clicking sound in courtship. Ear-drums or hearing membranes are on sides of body behind the wing bases.	Relatively inactive grasshoppers as compared with some of the smaller species. Adults commonly found from June through to November through most of the range. Commonly attempt to escape detection by hiding on the opposite side of the plant on which they are resting. Feeds on almost any kind of plant but common on low forms.	Food: leaves of plants on which insect is found. *Scudderia furcata* gives a soft, high, oft-repeated, *zeep, zeep, zeep,* from bush or tree; *S. curvicauda* calls *bzrwi* in day, and a shorter *tchw* at night; *Amblycorypha* gives a shrill *shrie-e-k; Microcentrum* calls a high, repeated *tzeet-tzeet-tzeet-tzeet-tzek-tzek-tzuk-tzuk.*
Of little economic importance probably but of tremendous interest because of the remarkable mimicry they exhibit.	Food is largely plants, of course. The species is not so likely to be abundant as are other species and therefore the insects are less likely to be considered as serious pests. It is known to cause serious injury to corn, wheat, alfalfa and soybeans. It is figured and discussed in Farmer's Bulletin, 747, U. S. Department of Agriculture.	Late fall plowing may destroy eggs in ground. Rolling of fields may kill young before they have developed wings. Hopper-dozers dragged across fields, and ditches dug through or around them, provide some control. Possibly some dried grasshopper bodies may be used as chick food or as fish food. This might make capture profitable and offset the normal losses they would cause.	One of the most destructive grasshoppers to alfalfa, wheat, corn, weeds and garden plants but not ordinarily favoring woody plants if other plants are available. In some years, have been serious pests but cultivation of land has reduced the menace. Excellent trout bait. See Farmer's Bulletin 747, U. S. Department of Agriculture for further information.	None of these is of great economic importance but all are interesting in part because of their songs. The calls of some of these are too highly pitched to be heard by persons with limited ranges of hearing.

FAMILY	TETTIGONIIDAE			
SUBFAMILY	Phaneropterinae	Copephorinae	Conocephalinae	
COMMON NAME	Broad-winged Katydid	Robust Cone-headed Meadow Grasshopper	Meadow Grasshopper	Meadow Conehead Grasshopper
SCIENTIFC NAME	*Microcentrum rhombifolium*	*Neoconocephalus robustus*	*Orchelimum vulgare*	*Conocephalus* sp.
DESCRIPTION	Length: to 2¼ inches, with front wing to 5/8 inch broad, light green and with veins that suggest the veining in leaves. Male: with sound-producing organ long, triangular, opaque and coarse dotted. Face: under-surface, fore and middle legs, greenish yellow fading to a clay-yellow. Sexes nearly equal in size.	Length: body, to 1 1/5 inches, with female slightly longer than the male. Female: with long bayonet-shaped ovipositor, nearly equal to the length of the body and with its tip exceeded only slightly by the wing tips. Antennae: as long or longer than the rest of the animal and curving backward. Head: pointed. Pale green or rarely brown.	Length: about 2 inches, from tip of wing to tip of head. Slender, pale green, with long, slender antennae. Head: slender, pointed. Eyes: relatively small and near front of head. *Conocephalus* is smaller and more slender and commonly with straighter ovipositor.	Length of body of most members of this genus: about ½ inch. Antennae usually longer than body. In most species, the ovipositor of the female is slender and straight but in *C. nemoralis* is curved. In related *Orchelimum*, body is stouter and usually over 2/3 inch long.
WHERE FOUND	Found most commonly in low bushes and shrubbery. Ranges from New York to Minnesota and south to Florida and California with related species extending range into northwest areas. The genus is essentially American with 26 species, of which 2 are found in the United States and the others mostly tropical in range.	Found in drier sandy areas from Cape Cod to Virginia and along the shores of the larger lakes inland. There are 101 known species of the genus in the world of which 16 are listed from the United States though some consider each of these numbers too small. They are all practically terrestrial.	Found in moist pastures and meadows, usually among grassy plants, with *O. vulgare* ranging from the Rocky Mountains to Atlantic Coast and generally common. Not commonly found high above the ground, even though suitable food might be available there.	Members of this genus favor dry uplands while those of the genus *Orchelimum* favor borders of wet spots. This genus is found in open fields, gardens, weed patches, orchards and similar spots. Over 90 species of the genus are known throughout the world, of which 14 are found in the United States.
REPRODUCTION	In early September, after mating, 2 to 30 eggs at a time are laid, day or night, in almost any place. Eggs are flattened. In May, the eggs hatch into young katydids that within 10 minutes begin eating and growing. By mid-July, the insects have grown from ⅛ inch long to a mature 2 inches or more and calling begins.	May sing night or day but particularly in early afternoons on cloudy days. Eggs are placed in grass tissue or in the pith of woody plants with assistance of long ovipositor. Usually eggs are placed close to ground between stems and root-leaves. Young hatch the following season into insects like adults but for absence of wings.	Eggs: laid in plant tissues with aid of the curved ovipositor; hatch in spring. Young: resemble adult in general form but do not develop wings until maturity is reached in early summer. No pupal stage of course.	Eggs are usually deposited in plant material being thrust in with the assistance of the ovipositor. The common *C. fasciatus* or slender meadow grasshopper may be found in adult form from July through September but in South it may persist into the winter. Winter is spent in egg form.
HABITS	Calling takes place at night. Males produce a series of 25 to 30 raspings with wing structures. Female answers with a single sharp chirp or "tschick" by sudden upward jerks of the wings. When temperature goes below 65° F. calling by both sexes stops. One female may in season lay to over 200 eggs.	Singing night or day sounds like buzzing of cicada or the prolonged humming of a bee. Exceedingly noisy. When disturbed, may hide on opposite side of a plant or fall to ground and stand on head leaning against a plant and most difficult to detect because of position and color.	Food: mostly grasses. Front-wings of males differ from those of female. In male, left front-wing overlaps right and by means of scraper causes a rasping sound when moved due to vibrating membranes. These sound-producing organs are on the wings close to body. "Ears" of cone-headed grasshoppers appear as 2 vertical slits on the fore-legs.	Sounds produced are weak and to one writer sounds like *"plee-e-e-e-e, tzit, tzit, tzit, tzit."* Other species have other songs but all are weak and to some barely audible. In open winter seasons nymphs of *C. fasciatus* may be found as early as March but this is not common in the North.
ECONOMIC IMPORTANCE	Probably of little economic importance but popular with those who like to live in the country because of the sounds produced at night. Known to eat cabbage, lettuce, purslane, apple, cherry and oak but apparently survive best on the leaves of the woody plants such as some of those listed above.	Feeds on plants but usually not those considered by man as of great economic importance. Most of the species feed on plants of relatively little economic importance and the animals are rarely in sufficient abundance to be considered as serious pests. Some species may burrow in sand to a slight extent.	Meadow grasshoppers are not commonly listed as being serious pests to grass crops in comparison with some of the other grasshoppers here considered.	These grasshoppers may cause some destruction to grasses and other economic plants but they rarely reach the abundance of the more destructive species. Someday someone will make recordings of the sounds of these insects and their relatives, to the end that we may learn to recognize them as we do the sounds of birds and amphibia.

TETTIGONIIDAE		GRYLLIDAE		
Rhaphidophorinae	**Stenopelmatinae**	**Gryllotalpinae**	**Gryllinae**	**Oecanthinae**
Cave Cricket	Jerusalem Cricket Sand Cricket	Common Mole Cricket	Field Cricket	Snowy Tree Cricket
Ceuthophilus gracilipes	*Stenopelmatus longispina*	*Gryllotalpa hexadactyla*	*Gryllus assimilis*	*Oecanthus niveus*
Wingless. Pale brown, or dirty white, with brown spots. With high, arched back and remarkably long, hind legs and antennae. Body: short and thick-set for a grasshopper, in female terminating in curved sword-like ovipositor. Lacks the sway-back of related sand-cricket.	Large, awkward insects without wings, with head bent forward and medium-long, slender antennae bent in either direction. Front legs and hind legs: much stronger than the middle pair and useful in getting animal through the soil. Abdomen: large somewhat arched and relatively shiny.	Length of body of male and female: from 4/5 to 1 1/5 inch. Brown to blackish brown. Front legs: shortened and remarkably suited for digging. Second and third pairs of legs: suitable for pushing body through the soil. Head: streamlined and rounded permitting pushing the way through soft soil.	Length, overall: about 1 inch. Female: with long, slender ovipositor which is lacking in the male. The smaller brown cricket *Nemobius* is possibly more common. It is 3/8 inch long, brown, with 3 darker abdominal stripes.	Slender, pale green. about ½ inch long, with long antennae. Female: with wings closely wrapped about body. Male: with more slender body, and with wing broader and relatively free and, of course, without long ovipositor. Male secretes, at base of wings, a liquid that female seems to enjoy eating.
Common in cellars and moist caves, or in woods, or gorges, or wells. Usually, where there is little light. There are at least 12 species of cave crickets or camel crickets in the United States. The related sand-crickets are found on the Pacific Coast.	Found burrowing in the soil since it lives practically wholly underground in burrows of its own preparation. Common in the West in the Rocky Mountain area and along the Pacific Coast. Technically it is not a cricket nor a native of Jerusalem. A single genus with several species.	Found from British Columbia to South America including much of Canada and on to Brazil. It is most commonly found in burrows and runways in soft soil near small lakes and ponds. Burrows may enlarge into side cavities. The genus is widely represented over the earth and 3 species are found in eastern United States.	Field crickets live in dwellings, fields, pastures and gardens. The cricket-on-the-hearth or house cricket, *Gryllus domesticus* is slender, yellowish brown, pale, with 3/5 inch body. It is native of Europe but has become established in America.	Commonly found singly or in pairs on trunks of trees or shrubs in late summer, with several species covering United States and Canada. Common species include snowy, the narrow-winged, the black-horned or striped, the four-spotted and the broad-winged, all of which are good singers.
Since these crickets have no wings, they can make no sound. Eggs: laid in late summer, probably in the ground, may hatch in fall but more commonly in the spring, into young nymphs that resemble the adults in general shape and may be found in early spring as wintering individuals.	Notes on reproduction indicate that the behavior is somewhat like that of other grasshoppers. The ability to make a noise and to fight indicates the possibility of courtship preceding the mating and egg-laying.	Females lay eggs in masses of 60 to 100, attached to rootlets, spherical, almost colorless, about 1/50 inch in diameter. The young may leap about actively but develop slowly it being reported that maturity is not reached until nearly 3 years have passed. Females show no visible external ovipositor.	In late summer or fall, the female lays several hundred eggs singly or in masses in holes in the ground. Eggs hatch in fall or spring. Those hatching from eggs in July may mature by mid-August. Immature crickets resemble adults but lack developed wings. No pupal stage.	Male sings. Female may approach and feed on liquid on back. Mate. Eggs deposited on bark or stems such as raspberry canes, 40 to 50 together; hatch in early summer into little crickets that resemble parents but for undeveloped wings. Reaches maturity by midsummer. Killed with advent of cold weather.
Food: meat, fruit, vegetables or almost anything organic and available. While cave crickets are not ordinarily considered of great economic importance the related Jerusalem cricket and western cricket, *Anabrus purparascens,* may be serious pests to crops in West sometimes reaching plague proportions and eating their own kind.	Sounds are produced by rubbing the hind or third pair of legs against the abdomen. The sound is similar to that produced by rubbing two pieces of sand-paper together. Sounds may be produced when the insect is annoyed and while it shows an aggressive fighting pose. "Cerci" at rear may serve to warn of danger from rear.	Food: plant material, earthworms, larvae of various insects. Song is a sharp, repeated, relatively loud 2-syllable chirp, difficult to locate but audible at over 10 foot distance, given in forenoon or afternoon but preferably on cloudy days. It sounds much like that of the snowy tree cricket.	Food: plant or animal matter, but mostly plants. Males begin singing by wing-rubbing about June and continue through August, purpose apparently being to defy other males. Chirps loudest when weather is brightest and warmest. Males will fight each other if confined, chirp pitch rising as fight progresses.	Generally most active at night. Males fly readily and give calls in unison with other males. Add 37 to number of times males call in 15 seconds to get approximate Fahrenheit temperature. Calling is done during night of warmer months and is described as "slumbrous breathing." Amply protected from enemies by coloration.
In certain sections of the West the related species referred to above are only too well known. The animal of the East is more of a curiosity than of a pest because of the fact that it is rarely found in abundance, — fortunately.	Omnivorous insects feeding on potatoes, roots, earthworms, insect larvae and other organic materials. Because of habit of sometimes feeding on potatoes is in some parts known as the potato bug though this name of course is more commonly applied to the Colorado potato beetle.	Probably somewhat useful as destroyer of other insects. It apparently does no damage to man's economic plants. Female is reported to be able to chirp, producing a single note in contrast with the male's two-note call. Call reported as at 130 to 150 a minute two octaves above middle C continued for 2 to 3 minute intervals.	May destroy grass, clothing, food and other materials. May be controlled by baits, such as sliced potatoes poisoned with Paris green or partly opened jars containing sweetened vinegar. Another bait is made of 1 pound of Paris green or white arsenic to 25 pounds of coarse bran, and 2 quarts of cheap molasses.	Young and old feed largely on plant lice and so are essentially useful to man. One species, *O. nigricornis,* may injure raspberry canes by laying eggs too closely together on stems but most other species do little if any damage, and much good so are worthy of protection because of pleasing music and useful food habits.

intelligent marshals who direct advances and retreats with well-obeyed disciplinary commands. This is in a way denied in the Book of Proverbs in the *Bible,* where we read: "The locusts have no king," etc.

Any good agricultural text will give you an abundance of figures showing the destructive ability of grasshoppers and their kin. Even more convincing may be what happened when you slept out some night in an open field and woke in the morning only to find that the insects had chewed your socks into a beautiful bit of lacework. Certainly, in these trying times, when the whole world is calling for more and more food, we are going to watch with great suspicion the activity of any animal that wants to eat what we want to eat ourselves. This means that grasshoppers must go, or must be kept under control in the great food producing areas. Corn, alfalfa, wheat, rye, potatoes and garden truck all may be injured for food in the field. These same foods, when kept in storage, may be injured by crickets, cockroaches and other members of this ubiquitous group. To keep them in control calls for all sorts of tricks of the gardener, farmer, merchant and housewife.

Farmers have learned that late fall plowing, after grasshoppers have laid their eggs, may bury the egg capsules so deep underground that the young insects can never get a start in life. Early fall plowing is not an effective control because the eggs are laid on the newly exposed surface. Once the insects have begun to develop, we use a great variety of means to get them under control. "Hopperdozers" are driven over fields and the insects that fall into them are destroyed. Baits are set that induce the insects to leave our food plants for more tasty arsenic, flavored with molasses. In some cases, farmers have used fire to fight grasshopper epidemics. This is not usually advised because only rarely does the fire destroy the eggs hidden in the ground at the time such fires are possible, but the fires may also be destructive of the valuable humus that is the backbone of our national prosperity.

Possibly, the wisest technique to follow is that of investigating and encouraging the activities of the natural enemies of these insect pests. There are hosts of these, ranging from the obviously conspicuous turkeys, quail and other birds that use the insects as food, to the skunks, shrews, and deermice that feed on them more secretively. But more important than any of these are the invertebrate parasites that prey not only on the adult insects themselves but upon their egg masses as well. To these should be added certain bacteria, which are known to be of use in limiting the multiplication and destructive power of many of these pests, and which, in some cases, particularly with the related beetles, can be applied by mass distribution methods. Then too, of course, we have the newer chemical sprays that either serve to provide stomach poisons for the destroyers of our wealth or, better yet, serve as contact poisons and stop the feeding activities of the animals once they have reached their goal. Unfortunately, we do not know all we should about the use of some of these wholesale control materials, and until we do we may reserve some judgment as to their ultimate importance.

Probably, the eventual winning of our battle against these insect foes will be effected by a combination of use of poisons, encouragement of natural enemies and agricultural practices that bring rain, sun and frost into play as controlling elements. It is not wholly unreasonable to predict that we may actually find some important use of these insects that has been unknown or ignored by those of us reared in our modern civilization. We may find, as we have in a number of other cases, that primitive peoples have recognized values we have been unable to appreciate; that they, unlike us, have now and then been able to turn a calamity into a blessing. Certainly, whatever the final decision may be, we will find our wits challenged by the activities of these common animals. We may use the animals directly in the form of a fancy breakfast food, or we may find that it is efficient to use them as food for other animals. These animals may have food value or may be of other worth to us.

Whatever methods we may use in attacking these animals we will probably find in the group some that are able to resist what we may do. They may not fight back. They will, of course, not be intelligent in what they do. But the requirements of the insects are so varied that no one or no few practices we may adopt are likely to meet the conditions set by the life habits of all. We may be able to destroy one kind of grasshopper, but another may take its place at another time or may make its attack at another place. We may learn how to fight the grasshoppers that attack the tops of wheat plants, but, then, those relatives that attack the roots may come into abundance. This is the sort of thing that makes life interesting.

It may sound absurd, but, if you can learn this year how far your local grasshoppers jump when they begin activity for the day, how much they eat and how much they destroy that they do not eat, what proportion of them that hatch this spring survive to breed this summer, you will have made a start in helping yourself and others to meet the threat they make to our productive capacity as a nation. Some of these little things may seem to have no significance, but the effectiveness of a hopperdozer is dependent on how far the hopper jumps and the direction in which it jumps, and the other points raised have similar practical applications.

So, in spite of the fact that there will be few orthopterans for you to hear or to study when this special insert reaches you, it will really be a good time of year to begin your investigations. When summer comes, the problem may be too big and too complicated for you to handle well.

Conservation Funds—Which Pocket?

THE present system of depending upon license fees and other special sources for funds ignores general public interest in conservation. It gives a pretext for claims that sportsmen pay all of the costs of protecting wildlife and, therefore, should control policies relating to it.

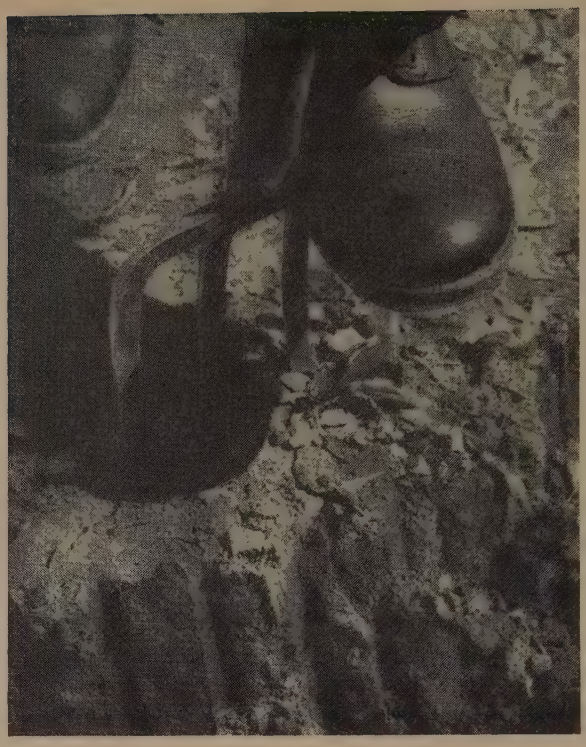
These claims, however, ignore the fundamental facts that wildlife is a product of the land, that insofar as produced by man it is by the landholders, and that it is also chiefly guarded by the landholders through their regulation of trespass. With all due credit to license and other special funds, it is clear that in all cases they bear but a small proportion to the total value of wildlife and of the businesses based upon it. Ten (and probably many more) dollars are spent for exploitation for every one used for production or restoration. The inevitable result of such a process is obvious. This result, total depletion, has been averted to this time only by the resilient productiveness of Nature and the land, a factor that, although the most important of all, is seldom even thought of, much less credited, as it should be, as the main source of resistance of our wildlife to the destructive forces that long have, and still do, assail it.

The American system of free public shooting has been upheld as ideal, and all encroachments upon it have been resisted even by those who should have been able to realize that it is an impossible ideal and has, in fact, never prevailed except under pioneer conditions. As private ownership of land became general, public shooting became impossible. If free to outward appearances, it was not free in reality, for the supply of game has to be paid for by someone, and so far in our history it has been produced at the expense of the landowner. Even the latest efforts to provide public shooting grounds in no sense of the word afford free shooting. It is costly and in this case, as always, a great deal more so to others than it is to the participants.

Contrary to the boasts of hunters, therefore, it can truthfully be said that their vaunted license and excise funds have, in general, played little part in the production of wildlife and still less in its protection. Wildlife, in all respects, is a publicly produced and publicly guarded asset, hence, with no reservations whatever, its conservation is a proper subject of public concern. This concern has been manifested in the high degree of protection given wildlife in all of our National Parks. This is a public, not a group achievement, and without it grizzly bears, bighorn sheep, and mountain goats would by now have been hunted to extermination in the United States. The greater part of the Federal wildlife refuge program administered by the Fish and Wildlife Service was no achievement of the sportsmen; in fact, in numerous cases, acquisition of areas naturally well qualified for refuge purposes was bitterly opposed by sportsmen. After some years, hunters were levied upon to the extent of a nominal fee for a Federal license to hunt migratory waterfowl, in contribution to the refuge program. The previous vast expenditures for refuges were necessitated chiefly by excessive slaughter of wild fowl by gunners, and the costly acquisition of some of the best areas would not have been needed except to keep hunters out of them and to protect the wildlife from extirpation. There is certainly another side to the expenditure matter, as it is costing the nation many millions to try to make up for the depredations of wildlife killers.

The National Audubon Society's refuge system and its conservation program have been paid for largely by people who were not sportsmen; this fact is made amply evident by the often manifested hostility of sportsmen groups to the "Audubonites." Nevertheless, considering the whole period of its existence and disregarding minor defects inseparable from all undertakings, this organization has been the most powerful force for conservation the nation has produced.

Claims, obviously false, that the sportsman pays his way and foots the conservation bills usually are made in connection with blustering remarks to the effect that "this is our show," and "we'll say what shall be done." If the pretension of these license feesters can possibly be humbled, it should be by realization that except for their own destructiveness, there would be no need of special efforts at wildlife conservation. Certainly the non-shooting, non-trapping elements of our population are not, and never have been, responsible for the despoliation of wildlife that has resulted in its essentially continuous decline throughout our history. In any stage of the decline, if hunters and trappers had only stopped their killing, wildlife would have prospered far better thereafter. In plain language, the retort to those who claim (albeit falsely) that hunters pay all the costs of protecting wildlife is: but for their persecution it would not need protection. Due to their persistence in slaughter and insistence on shooting privileges, it has become necessary for the public and non-supporting organizations to take positive steps to assure some degree of wildlife conservation before forever too late. Vast sums have been spent in efforts to conteract the effects of long-continued abuses of hunting privileges, and plans are made for even greater expenditures. Not only conservation, but outlays for it, being of decided public interest, should be publicly controlled.



Dig in for Friendship

By ANDREW S. WING
National Garden Institute

THERE is a war on—a war against empty stomachs, which beget rickety children, undernourished adults and political and economic chaos. The headlines may have changed when this appears in type, but the basic situation will be the same. Only a season or two of bumper harvests all around the world will change that situation. And to meet it, a large share of the food the world will have to eat must be grown in the western hemisphere and north of the Equator, and flow from there for the relief of hunger in Europe and Asia.

This means that you and I will have to put the shovel, hoe and rake to work as we did in Victory gardens during the shooting war. And we will not only have to ply these tools for home and community beautification. We need food, more, indeed, than we need flower borders or divits dug on the golf course. (I hope the Editor will pardon this reference to one of his favorite diversions.) [Okeh, Andy, but it is spelled "divots". Ed.]

Basic facts are clear and startling. We must either tighten our belts more than most of us care to do. or grow more food in our own home gardens. Putting the matter a little more bluntly, we either grow more of our own provender in our own backyards, or we must pay a lot more for the food that we buy at the stores than most of us can afford to pay. The cost of food has sky-rocketed more than forty percent in the past year, reaching an all-time high.

Secretary of Agriculture Clinton P. Anderson warns that meat supplies will be scarcer in 1948, and that prices will be higher. The reason must be obvious to everyone who gives the matter of grain a thought. Farmers cannot grow and fatten more beef, lamb and pork until grain becomes more plentiful for such purpose.

Meanwhile, we are faced with the uncertainty of weather in the next growing season. Recent reports from the former dust bowl are disturbing, indeed. From that region during the war came much of the wheat that we sent overseas. Our surplus of grain, meaning our normal carry over, no longer exists. We are scraping the bottom of the bin now. Should we experience next season a crop failure in wheat or corn, or any other major crop, the situation might become very critical indeed. Meanwhile we are committed to a program of exporting all that we can to feed hungry people in Europe and Asia.

The old adage says: "The Lord helps them who help themselves," and it certainly applies to gardeners this season, for farmers and gardeners are the only groups that are in a position to help fill their own food baskets these days.

Does a home garden really pay? The answer is yes. But how well it pays depends on you and your home surroundings. Assuming that you have a plot that receives at least six hours of sunshine a day, is well drained, and has a fairly fertile soil, even if it is in your front yard, a food garden will most certainly pay. Yes, even if you only set out a few tomato and lettuce plants in your flower border, you can count on some food that will be both cheaper and tastier than that which you buy. And every pound you grow and consume will be saving just that much critical food that can be shared with our cousins overseas, or with your less fortunate brothers in the city who do not have access to a plot of soil of their own.

It is conservatively estimated that even a small garden, say twenty by thirty feet, can save at least $50 a year in food bills. If you have larger grounds with some fruit trees, berry bushes and asparagus, it is possible to save $500, or more, especially if a considerable amount of canning or freezing is done. These figures vary greatly, of course, depending on conditions of soil and climate, and on the zeal and aptitude of the gardener. During the war many of

us who were engaged in Victory garden work marvelled at the crops of vegetables that unskilled gardeners grew on barren lots that lacked humus and were low in fertility. These people made things grow simply by loving them and nursing them along. Children work wonders in tiny plots, making some of the old experienced hands look like dubs. Certain people are born with "green thumbs", it is said, but more often it is just infinite capacity for taking pains that gets results in a garden.

What to plant will depend somewhat on the size of your garden, the personal tastes of your family, and local market conditions. Tomatoes nearly always pay good dividends, both in quality and in production. You will not go wrong in planting several rows of sweet corn if you have the space. But in a small garden it is better to devote the space to the more intensive crops such as lettuce, bush beans, broccoli, and the root vegetables such as carrots, beets, onions, or, if you like them, the greens, such as Swiss chard, New Zealand spinach, kale, tampala, or turnips.

A garden is not a garden to me unless I can include a few specialties such as leeks, Chinese cabbage, endive and the vine crops. Bush squashes do not take much room, and they are extremely prolific. The vines of the other squashes, such as Acorn and Hubbard, can be allowed to grow between rows, or over on the grass next to the garden. Some people train squashes and cucumbers over picket fences and walls to save space. The main pests to watch with the vine crops, including cucumbers and melons, are the squash bug and the squash borers, which can ruin plants in no time at all unless checked. Melons are perhaps as difficult to grow as anything in the home garden because of their susceptibility to blights and bugs, but it can be done if you are willing to take the pains. The best insecticide for squash borers—the grub that digs into the stems near the ground and eventually kills the plant—is rotenone. Sabadilla is a new insecticide that is especially effective with squash and cucumber beetles, which have huge appetites, and cause havoc.

Plan your garden carefully. This is particularly important with a small garden. Do not give an inch of space to crops that your family does not enjoy, or to those that you may be able to buy more cheaply at the corner store. In a larger garden you can afford to indulge your fancy to some extent, and, perhaps, do a little experimenting. Novelties are fun to try, but are not always best for maximum food production. Draw a map of your garden and figure out exact footage. It is easy to overplant such things as Swiss chard and radishes. A ten-foot row of chard will supply enough of this excellent vegetable for the average family.

Radishes are one of my favorites, especially early in the season. I also like turnips sliced thin, chilled and eaten raw. Kohlrabi is an excellent vegetable, either raw or cooked. Some friends make cole slaw of it. Turnip-top greens are another of my weaknesses. Most southern people love them. But all of these "coarser" vegetables leave my wife and children cold. How to educate families to eat more of the green and leafy vegetables is one of the problems that our garden experts in Washington have not yet solved. Perhaps better cooking is the answer. Maybe school lunch cafeterias where vegetables are well cooked and served to hungry youngsters who are not under the maternal eye will help break down some of these prejudices.

But there are certain things that almost everyone likes. Tomatoes, sun-ripened and fresh from the garden, are one. Sweet corn, picked and husked while the pot is boiling, is another treat few can resist. Peas shelled while still full of natural sugar are superb. And if you never tried the edible-podded peas, old in Europe and in the Orient but unknown to most Americans, you have a treat in store that will really tickle your taste buds.

Three or four kinds of lettuce, ranging from the loose-leaf types to the Cos or Romaine, and a short row of curly endive, will make your salads most in-

The well-planned home garden, with provision of enough space for a variety of vegetables, but not too much for any one, will return dividends in fresh food, savings in these days of high prices, and make easier the task of meeting the need for shipments of food to peoples less fortunately situated than we in the United States.

Community gardens on acreage of substantial size should be seen growing again in 1948 as they grew during the war years. Young and old will find healthful work, valuable and delicious produce in such gardens. Some of the young people will surprise the oldsters by their aptitude for growing things and by their successful results.

triguing. Plant lettuce in short rows every two or three weeks, and do not hesitate to yank it out and plant something else as soon as it is past its prime. I used to think that growing cabbage at home did not pay. Soaring prices, and the fact that the home-grown kind picked young and tender does taste better, either cooked or raw, have changed my mind. You can buy carrots that are about as tender and smoother than most of us can grow, although young carrots and beets that you gather early in the season are tastier. For winter storage I like the big Winter Keeper beets that grow to mammoth size without losing their natural flavor and sweetness. The tops are also good for late greens.

The bean family is indispensable, both because its members taste good on the table and because they are rich in protein and make good meat substitutes. The bush snap beans, either green or wax, are best for general purposes, but nothing is finer in flavor than Kentucky Wonder and some of the other pole beans. But they must be picked young. And a row of limas, either bush or pole, will supply you with some wonderfully tasty dishes, either cooked fresh or from the freezer. And this may be the year when it will definitely pay you to install that freezer you have been thinking about, or at least a new refrigerator that has a freezer compartment. New varieties of vegetables, such as peas, are now being developed just for freezing.

Broccoli is another vegetable that is easy to grow. Just keep the heads cut back and watch for cabbage worms and aphids. In quality and tastiness it seems to rank ahead of all the members of the cabbage family, not excluding cauliflower and Brussels sprouts.

Next I would rank the summer squashes, perhaps. with Straightneck and Zucchini running a close race for top position. A touch of onion or garlic helps to make these more tempting on the table. After these would come Butternut and Acorn squash. Or it may be that you would put plump, sugar-sweet young peas, or baby lettuce, or succulent young carrots or beets at the top of your list. It does not really matter just so you pick them at just the stage when quality is supreme.

For a few novelties that are not new but decidedly worthwhile, try eggplant and leeks. The latter makes the most superb soup when mixed with potatoes. or when ground up and strained the mixture is one of the supreme delights of the culinary world—vichysoisse, which, eaten either hot or cold, is a rare treat. Eggplant, too, is a vastly underrated vegetable, and is one of the handsomest plants to grow in the garden. or to use as a table decoration.

So much for appetite appeal. The savings from a home garden are also very real. When you can go to the garden any time in late summer and gather ten or twelve different kinds of vegetables, the produce becomes a real asset on the kitchen table. Most of us hate to waste anything, or discard it as it gets stale. But discard you must if you are to keep food quality up to standard. The hydrator in the average home refrigerator is a repository (or perhaps a morgue) for the decomposing remains of what were once good vegetables. So is the average vegetable bin. It requires stern self-discipline, and a little education of the cook (even if she is your wife) may be necessary in order to prove to her that stale vegetables are not fit to eat, except possibly in soups and stews. As vegetables become withered and dry, studies show, the vitamin content declines, and so, certainly, does the tastiness of the product served on the table.

In winter, when vegetables (Continued on page 105)

In *Nature Magazine* for June-July, 1947, Miss Huggins wrote of the various plants that are symbols of long life to the Chinese, and that have found their way into the Chinese arts and crafts. Various animals have similar significance, and the author, who has lived, taught and studied in China, now rounds out the story of Nature longevity symbols with this interesting story of—

Cicada, Tortoise, Dove, Hare, Deer and Crane in Chinese Symbolism

By MABEL IRENE HUGGINS

This silk tapestry, rich in long-life symbols, portrays an Immortal, probably Ma Ku, who carries a sacred fungus in one hand and has a double gourd hanging from her girdle. Both the Immortal and her companion, the "prunus-blossom" deer, are overshadowed by a fruit-laden peach tree that grows from the side of a rocky cliff. Bamboo and sacred fungus also find root-hold in clefts of the rocks.

Cicada amulets (left) were buried in the mouths of the dead in the Han Dynasty (206 B.C.-A.D. 220). Both pictures courtesy Freer Gallery of Art, Washington, D. C.

IN China longevity symbols from Nature are not limited to the peach, the gourd, the "three friends," the sacred fungus, and *Rohdea sinensis*—those members of the plant kingdom that signify long life and immortality to the people of China. Animals also serve.

From studies of the remains of the Shang Dynasty (1776-1122 B.C.). the earliest known civilization in China, a good deal was learned concerning the domesticated and wild mammals that figured in the life of the people. Two of them that were represented in the pictographs on the Oracle Bones from those remote days were the deer and the hare, both of particular interest to us because they are longevity symbols. Two lower forms, the cicada and the tortoise—likewise shown in those ancient pictographs—are also long-life emblems.

The hare, which is supposed to reach an age of 1000 years, is thought to become white when it arrives at the halfway point in its life. Painting by an artist of the Ming Dynasty (A.D. 1368-1644). Courtesy, Miss Alice Boney, N. Y.

The cicada, in addition to appearing on the Oracle Bones, is believed to have been the inspiration for a geometric pattern that decorates some of the Shang bronzes.

In the Han Dynasty (206 B.C.-A.D. 220) the cicada had a distinctive function in the customs of the people, inasmuch as cicadas carved from jade were placed in the mouths of the dead before burial. Many of those jade cicadas have come on the market in Peiping during recent years.

Perhaps no more accurate description of the cicada's song has ever been written than came, almost nine centuries ago, from the writing-brush of the poet Ou-yang Hsiu, who wrote that in the hushed courtyard

An important part of the equipment of a Chinese writer or painter is an inkstone on which he grinds his ink. This stone in the form of a tortoise comes from the Han Dynasty (206 B.C.-A.D. 220).

of the Wine Spring Temple he heard—

".....a thing that cried
Upon a tree-top, sucking the shrill wind
To wail it back in a long whistling note—
.....
Now shrill as flute, now soft as mandolin:
Sometimes a piercing cry
Choked at its very uttering, sometimes a cold tune
Dwindled to silence, then suddenly flowed again,
A single note, wandering in strange keys.
An air, yet fraught
With undertone of hidden harmony."

From the poetic comments of Ou-yang, it is plain that the metamorphosis of the cicada savored largely of magic. It was also the common talk of the time that these amazing insects grew neither "old nor languid" on a diet of nothing but dew and wind.

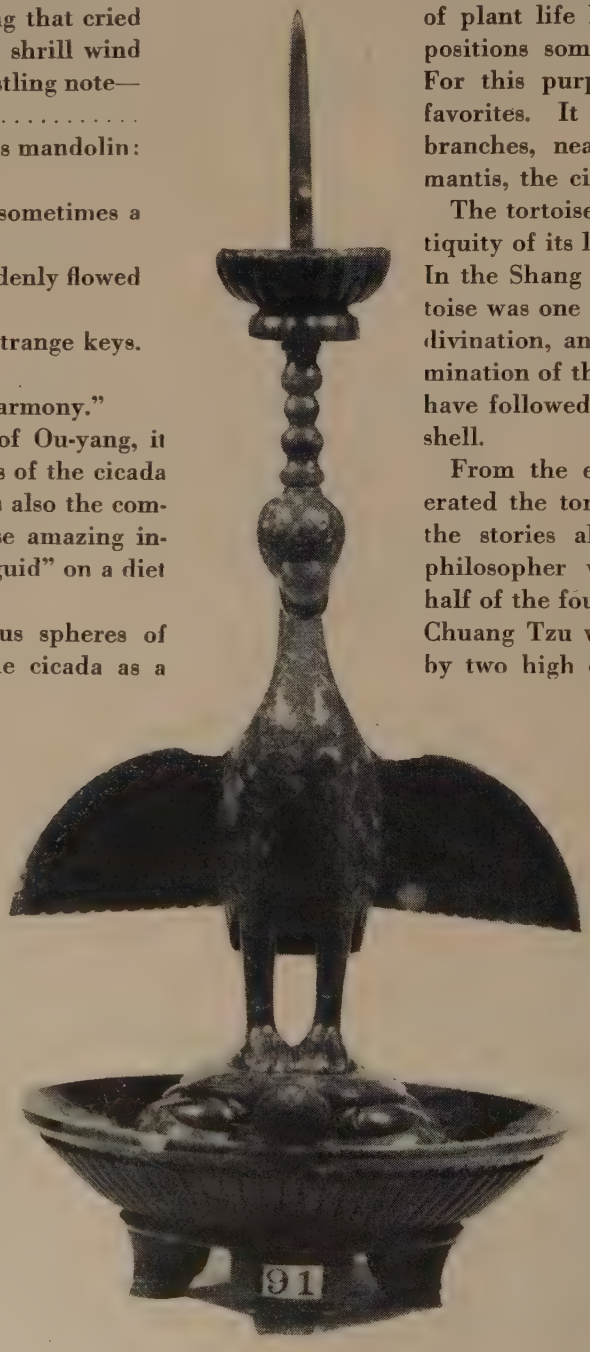
In more recent times various spheres of artistic endeavor have used the cicada as a motif. A snuff bottle of hair crystal fashioned in the form of a cicada bears a remarkable semblance to the live insect. No other material could so well simulate its filmy wings with their dark veinings.

We do not generally think of the manufacture of ink as being a field for art, but in China it is nothing less. To painters and scholars the solid sticks of ink are necessities of the highest order, so, as befits their position, they are decorated, often with rare beauty. Cicada-shaped ink sticks are sometimes made.

Chinese painters feel that a vivid quality can be added to their pictures of plant life by introducing into their compositions some member of the insect tribe. For this purpose the cicada is one of the favorites. It usually accompanies willow branches, near which may lurk a praying mantis, the cicada's chief enemy.

The tortoise vies with the cicada in the antiquity of its legendary and historic allusions. In the Shang period the carapace of the tortoise was one of the favored "bones" used for divination, and it is believed that the extermination of the species then in existence may have followed from the great demand for its shell.

From the earliest times the Chinese venerated the tortoise, as is suggested in one of the stories about Chaung Tzu, the Taoist philosopher who lived during the second half of the fourth century B.C. One day while Chuang Tzu was fishing, he was approached by two high officials who told him that the Prince of Ch'u, having heard of his wisdom, wished to turn over the administration of the State to him. To this proposal Chuang Tzu replied: "I have heard that in Ch'u there is a



In this jade candlestick a crane stands on the back of a tortoise, alluding to the legend of Buddha's effort to cross the raging stream. The interior of the bowl-like base is decorated with swirling waves in low relief. Two serpents twine themselves around the tortoise. 18th-19th Century. Courtesy. Walker Art Center, Minneapolis.

This pair of cranes forms part of the decoration on a tomb tile of the Ch'in Dynasty (255-206 B.C.). Collection of The William Rockhill Nelson Gallery of Art, Kansas City, Missouri.

sacred tortoise which has been dead now some three thousand years. The prince keeps this tortoise carefully enclosed in a chest on the altar of his ancestral temple. Now would this tortoise rather be dead and venerated, or alive and wagging its tail in the mud?" The visitors agreed that it would prefer mud and tail wagging. "Begone!" exclaimed Chuang Tzu. "I too will wag my tail in the mud."

Bronze mirrors of the T'ang Dynasty (A.D. 618-907) were sometimes decorated with the Four Sacred Animals, which were thought to preside over the four principal directions and the four seasons, the tortoise—otherwise known as the Black Warrior—representing the north and the winter. A serpent may be twined around the tortoise, a portrayal of the ancient belief that the tortoise is always female and can only reproduce by mating with a snake.

In some paintings, the God of Long Life is followed by a patriarchal tortoise with a hairy back and tail, an indication that it has already reached an advanced age, as it is said to develop that characteristic when it is well on its way to its 5000 years, the limit of its lifetime. Those of a more scientific turn hint that the tortoise's tail and back are laden with *Spirogyra*.

One of the most notable evidences of the veneration of the tortoise is found in Chinese cemeteries, where monuments have been dedicated to distinguished personages—emperors or important magistrates. These monuments are made of big marble slabs stood upright on the backs of huge stone tortoises.

But the great and the near-great probably do not find as much enjoyment in their tortoise-based monuments as the lesser folk of the Amoy area find in their tortoise-shaped birthday cakes. In that region, and possibly in some other portions of China as well, a favorite birthday treat is a steamed cake made of glutinous rice flour with a filling of jujube, peanut, or sweet bean paste. Such cakes are about a foot across and three-fourths of an inch in thickness. Peach-shaped molds are also used for making these birthday cakes.

Another long-life symbol is the dove or pigeon, the most common wild species being *Streptopelia orientalis*, which is found through-

This representation of the moon, one of the 12 imperial symbols from a ceremonial robe of yellow *k'o ssu*, shows the Moon Hare engaged in making the elixir of immortality. Ch'ien Lung Period (A.D. 1736-1795). Courtesy, The Minneapolis Institute of Arts.

A cicada on a willow branch is being watched by a praying mantis in this detail from a painting by Yu Fei-an, a contemporary artist in the freehand style. Corliss Hathaway photograph. Author's collection.

out the length and breadth of China. Domesticated pigeons are kept in large numbers and contribute their share in providing both meat and eggs for food. In the best restaurants such dishes as Pigeon Egg Soup and Braised Pigeon Eggs are available, and are looked upon as great delicacies. Eggs, be they duck, hen, or pigeon—due to their round form, which is without end, are symbolic of long life.

Until modern times China has, to a large extent, been custom-bound, so we need not be surprised that there have been regulations that have gone so far as to govern the use of a gentleman's walking-stick. At the age of 50 a man was permitted to use a staff at home; at 60 in his village; at 70 in the capital; and at 80 at court. From the Han period it was the custom to present to persons over the age of 80 a "pigeon staff"—so called from its pigeon-like handle. It was the general belief that the pigeon's digestive powers were out of the ordinary, hence, a pigeon on an aged person's staff implied the wish that his digestion might serve him well and bring him to even a greater age than he had already attained. This, no doubt, was the basic idea in establishing the pigeon as a symbol of longevity.

Mottled gray and green jade with bright green markings was an appropriate medium for this vase which was wrought in the form of a gnarled pine stump with twisted branches in high relief. At the sides are figures of a crane and a deer, the latter holding a sacred fungus in its mouth. Ming Dynasty (A.D. 1368-1644.) Courtesy, Walker Art Center, Minneapolis.

The hare, also emblematic of longevity, is supposed to reach the age of 1000 years, and it is thought that it becomes white when it arrives at the halfway point in its life. Many, however, do not have a chance to grow hoary, because they are the object of the marksman's aim or the snarer's trap, and consequently they are abundant in the game markets. This is an old story to the hare, for the early pictographs show them as being caught in nets. A little later, during the Ch'in Dynasty (255-206 B.C.), tomb tiles were made vividly portraying the chase with horsemen and hunting dogs in hot pursuit of hares and deer.

The Chinese hare, *Lepus tolai* and its subspecies, has always been a hunted thing, but in myth and legend it has fared somewhat better. According to a Buddhist tale, the hare once sacrificed itself in order to provide food for Buddha when he was hungry, and as a reward for the generous act it was transported to the moon, where it appears to the Chinese as clearly as the Man-in-the-Moon does to Westerners.

Another myth tells that Ch'ang O stole from her husband the pill of im- (Continued on page 108)

Left, a specimen of the clear-wing sphinx moth, *Hemaris senta*, that was reared. The wings had remained powdered with black for six hours, but all the powder blew off with one flutter of the wings after the insect was placed in a cyanide jar. The label can be seen through the left wing. Right, another specimen that was killed quickly with little loss of the black powder. In the center, an empty pupal case.

The Mystery of the Black Powder

By WILLIAM H. EVANS

THE text accompanying the photographs of the life history of the tomato sphinx moth in the August-September *Nature Magazine* states that the scales are believed to be rubbed off the transparent parts of the wings of the day-flying hummingbird moths as these moths emerge from the pupal stage. This statement refers to those species of sphinx moths usually called clear-wings, but more accurately termed clear-wing sphinx moths, since the name clear-wing also includes moths belonging to other families. I was able to discover this explanation to be incorrect when I observed the emergence of two adults of the California species, *Hemaris senta*, in July, 1941. Actually both surfaces of the central areas of the wings remain covered with a thin powdering of black scales until the moth flies. The photograph depicts the results of my experiment. Unfortunately I did not have the equipment to photograph the early stages of *H. senta;* however they are so similar to those of other members of the family Sphingidae that a brief description should suffice.

In Los Angeles County this species is found wherever the wild honeysuckles grow, from sea level to an altitude of more than 6300 feet in San Gabriel Mountains. The two green, spherical eggs that I found were on the tender leaves of the common foothill variety of honeysuckle known as *Lonicera subspicata* var. *johnstonii*. Each of the newly hatched caterpillars was pale yellow, with a black caudal horn almost half as long as the body, changing after the first moult to pale green, with a yellow horn much shorter in proportion to the length of the body. When they reached maturity, after moulting four times, the caterpillars were bright green with deep purple on the under sides. They spun cocoons on the surface of the ground, binding together small pieces of twigs and leaves with a thin network of very tough silk. After thirty-six days in the larval stage the caterpillars shed their final skins. The pupae, which had no special cases for the tongues, were translucent green at first but soon changed to dark brown.

After twenty-four days in the pupa a perfect moth emerged, its wings covered with black scales. Six hours later, when I placed it in the cyanide jar, the wings were still powdered. It fluttered its wings only once—then it was a clear-wing! All the black scales, except a few along the veins, merely blew off the middle of the wings, and fine black dust floated around inside the jar, settling on the bottom.

When the second moth emerged I was determined to preserve it with at least some of the black powder on the wings; therefore I killed it as soon as the wings expanded to full size, but before they became stiff. All the scales stayed on, but the wings were too limp to be spread out properly. After the moth dried out thoroughly, I relaxed it in a tin can containing some moist paper; then it was easy to move the wings forward to the correct position. As the illustration shows,

very few scales were rubbed off in this process, in contrast to the other moth.

There is still much research to be done on the clear-wing sphinx moths; for, although the habits of all the kinds are probably similar, no one can be certain of this until the emergence of every species in the genus has been carefully observed. Then someone may be able to explain the purpose of the temporary black powder; or, perhaps, it will always remain one of the great many unexplainable mysteries of Nature.

Cane

By W. L. McATEE

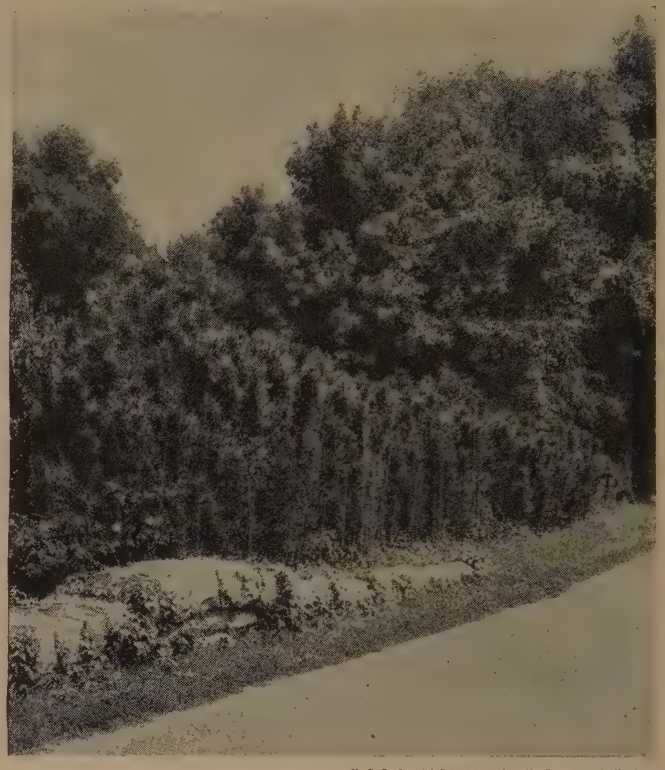
LINGERING in memory is the statement that luxuriant growths of cane were what enabled the buffalo to penetrate eastern woodlands, even as far as central Pennsylvania. Yet cane has not recently been seen north of mid-Maryland, and apparently there are no dense stands anywhere in the northern parts of its range. These are somewhat puzzling facts, but light can be thrown upon them.

In Kentucky, the French botanical explorer, Michaux, wrote in 1804: "Before occupation by the Europeans the forest floor, bare today, was covered by a large, jointed cane, which in woods was 3-4 lines in diameter and as much as seven feet high, but which attains 20 feet in swamps, bordering the Mississippi, and acquires thickness in proportion. Although the temperature in Kentucky descends to 5-6 degrees for several days together, the leaves of the cane remain green and appear not to be damaged by the frost." And with reference to both elk and bison he adds, "the great quantity of the large canes and of wild peas furnish them abundant food the year round."

Materially filling in the picture, the British geologist Lyell, discoursing on the same State in 1845, said: "These forests, where there is no undergrowth, are called 'wood pastures.' Originally the cane covered the ground, but, when it was eaten down by the cattle, no new crop could get up, and it was replaced by grass alone."

There is a peculiarity in the life history of cane that makes it vulnerable to heavy grazing. It blooms and seeds but once, then dies. Sometimes the intervals between seedings are as long as 25 years so that people hardly remember the previous maturing. These long unreproductive periods only increase the grazing hazard because livestock continue to reduce the number of plants while there are no replacements. Thus in the northernmost, and presumably least favorable, parts of its range, cane has apparently been nearly or quite extirpated. Hence, if animals largely dependent upon it (as the buffaloes were said to have been) had not been shot away, they would have been driven out by the competition, for the nutritious cane, of grazing cattle and rooting swine. The plant has been extensively depleted by domestic animals, also, in the South, where its most favorable habitat is found.

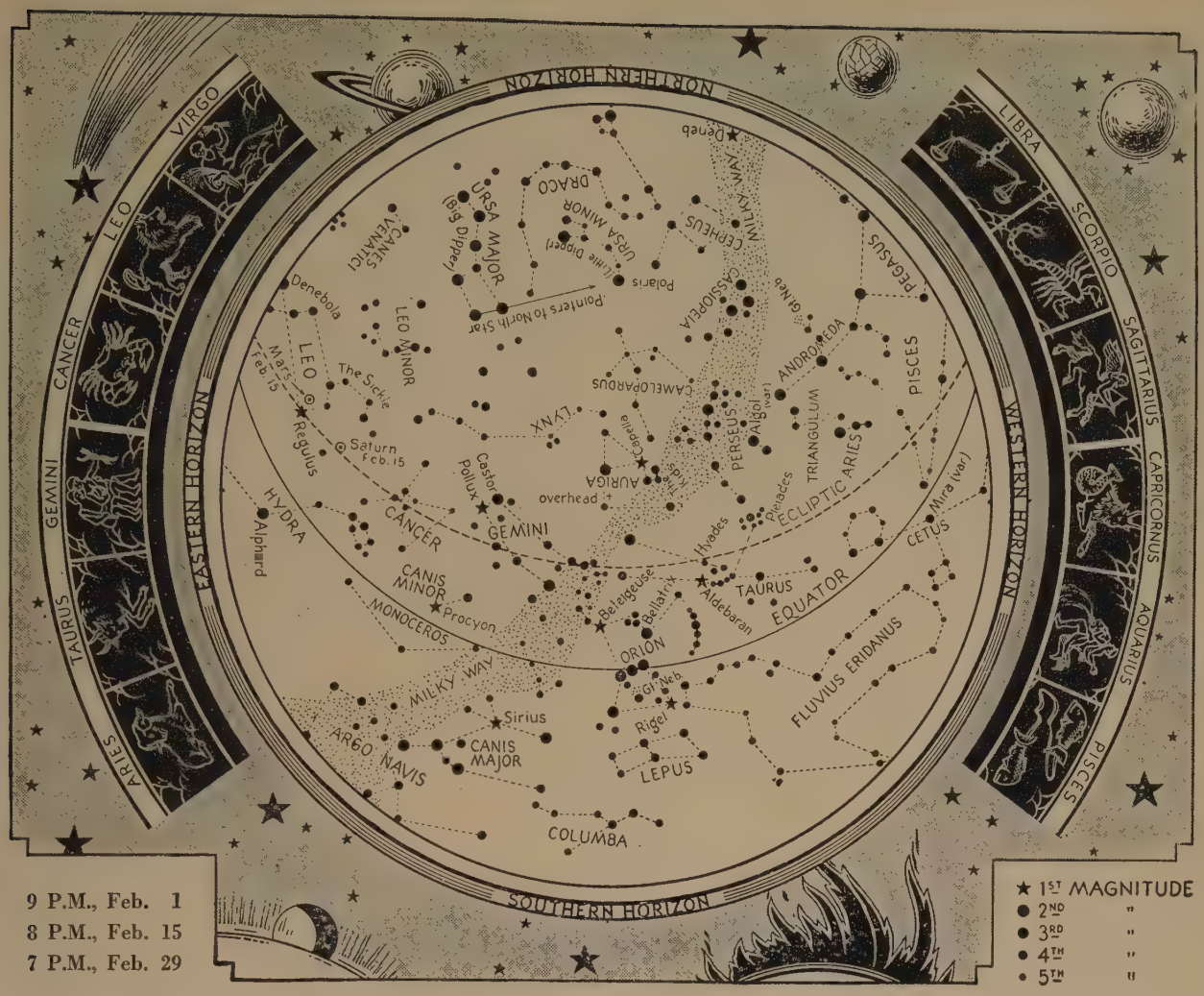
As I have seen cane in the vicinity of Camp Meade, Maryland, it was only three to four feet high. Michaux gives it a range of seven to twenty feet, and Bartram, in the 1780's, found growths in the Mobile River delta in which the stalks were thirty to forty feet tall, and three to four inches in diameter. Some botanists treat canes as of two or three species; others consider them one.



U.S.D.A. PHOTOGRAPH BY R. A. YOUNG

Cane, *Arundinaria gigantea*, growing up to fourteen feet high in the Swannanoa River valley, Biltmore Estate, Biltmore, North Carolina.

Cane is of the bamboo alliance, and shares the properties of lightness and strength so characteristic of that group of plants. From cane-brakes such as Barton saw, granting they contained some lesser growths, good fishing-rods could have been selected. Canes have, in fact, had rather extensive employ for fish-poles. The Indians used the smaller plants for pipe-stems, mats, and basketry. White boys have fashioned the hollow joints into popguns, and their fathers have found them useful in making turkey-calls. One of the latter before me has three telescoping sections; when drawn out and a low, sucking, smacking sound is made by the lips across the small end, there comes out of the larger end a note more or less resembling (according to the skill of the operator) the "turk" or "yelp" of the wild turkey. With a row of small to large sections of cane, a pipes-of-Pan could be made, but to get music from it would require a redoubtable blower.



To use this map hold it before you in a vertical position and turn it until the direction of the compass that you wish to face is at the bottom. Then, below the center of the map, which is the point overhead, will be seen the constellations visible in that part of the heavens It will not be necessary to turn the map if the direction faced is south.

Does Life Exist on Mars?

By ISABEL M. LEWIS

THE report of Dr. G. P. Kuiper, Director of the McDonald Observatory, that examination of the infra-red spectrum of Mars revealed the presence of carbon dioxide in the atmosphere of Mars in an amount equal to, or even somewhat greater than in the earth's atmosphere, is of great importance and interest. The additional discovery that no other gases with strong absorption in the infra-red were present, such as the poisonous gases methane and ammonia found in such abundance in the atmosphere of the outer planets, further strengthens the belief in the possibility of life on Mars. The presence of carbon dioxide in the atmosphere is essential to the growth of plant life, and it shows that the Martian atmosphere also absorbs more heat and has a greater blanketing effect than would be possible without its presence. As carbon dioxide is also a product of animal life, its presence in the Martian atmosphere suggests the possibility of animal as well as plant life on the planet. This is especially possible since oxygen, as essential to animal life as carbon dioxide is to plant life, has been found in the atmosphere of Mars, although occurring by no means as extensively as in the earth's atmosphere. The presence of carbon dioxide in the atmosphere of Mars explodes the theory, so often advanced by those who opposed the belief in the existence of life on Mars, that the polar caps consisted of frozen carbon dioxide instead of ice or snow.

On February 17 Mars will be at opposition and also nearest to the earth for this particular Martian year, although at the most unfavorable of all oppositions. The distance from the earth of approximately 63,000,000 miles on that date will not be exceeded at any opposition by more than a few thousand miles, while at a favorable opposition, such as will not occur

again for several more periods of revolution relative to the earth of 780 days each, the planet will be less than 35,000,000 miles distant. This does not rule out the possibility, however, that much interesting and valuable information may be acquired regarding this small planetary neighbor of ours before the next most favorable opposition.

The discovery of carbon dioxide in the atmosphere of Mars was made with a new type of infra-red spectrometer that contains a small cell sensitive to the infra-red spectrum. It was this spectrometer, also, that proved the non-existence in the atmosphere of Mars of poisonous gases with strong infra-red radiations. It is probable that the greater part of the atmosphere of Mars consists of nitrogen, which has no bands in this part of the spectrum. During this month, when the white polar cap of Mars and dark regions, greenish in color, are studied with the new spectrometer under the most favorable conditions for this opposition, new facts may be discovered that will help to solve the problem of the possibility of life on other worlds.

It may not be long now before one of the longest controversies among astronomers—one that has lasted for seventy years—may finally be solved through the immense light-gathering power of the 200-inch Mt. Palomar telescope. Ever since the Italian astronomer Schiaparelli, in 1877, announced the discovery of a network of fine, hair-like lines on the surface of Mars, there have been two groups of observers who have flatly contradicted each other as to the objectivity of these "canals," as they were called. According to Dr. Edwin Hubble of the Mt. Wilson Observatory, in a lecture delivered in Pasadena, California, in April 1947, on some problems that may be solved by the new telescope, it may soon be possible to photograph with this instrument all that the eye can see with a telescope of moderate size, because of the great light-gathering power of this telescope. If the canal system can be shown to be real, Dr. Hubble states, it would almost necessarily imply the existence now, or in the past, of intelligent beings on Mars. Although many observers of Mars have made drawings of the canals, glimpsed in moments of superlative seeing, it has been impossible so far to photograph the canal pattern. These consist of many fine dark lines that appear, when viewed visually in even moderate-sized telescopes, to run along arcs of great circles and converge or cross at spots called "oases."

There are a number of reasons why photography of the canals of Mars has so far been unsuccessful. The light gathered from the planet's surface at the primary focus of even the powerful Mt. Wilson reflector gives so small an image that an enlarging lens of considerable power must be used to obtain an image suitable for photographing. This means that the light is greatly reduced, to begin with, by being spread over a large area. In addition, the red or orange filters used in the photography of the planet produce a still further reduction of light. It follows that time exposures are necessary. Even though these exposures may be only a second or so in duration, the dancing of the image due to atmospheric effects is generally so great even in this short period of time that it may be fatal to a delineation of the intricate detail and thread-like imagery of the canal system. The human eye has the advantage that, even with a moderate-sized telescope and less magnification of the image, it may seize upon the rare moments of perfect seeing to glimpse and record the appearance of the network of canals that have been depicted in drawings by many different observers. It is to the great light-gathering power of the 200-inch telescope that astronomers now turn with the hope that finally the much debated question of the objective reality of the canals of Mars may be settled. Should the existence of such an elaborate and intricate system be established beyond doubt, then its artificial appearance and geometric regularity show clearly that intelligent beings have accomplished a great engineering feat on this neighboring world. The scarcity of water on Mars, evident from the nature of its surface markings, which reveal the existence of large, reddish, desert-like areas, would require a careful conservation and economical distribution and control of all available supply. It would be to the seasonal melting of the polar caps that the inhabitants of the planet would look for the chief source of their water supply, and the canal system could be the great irrigation system of the planet designed to distribute this meager supply where it would be most needed.

Compared to our own planet, small as it is itself, Mars is a tiny world. It has a mass only one-tenth that of the earth and a diameter of 4200 miles, not much more than half that of the earth. The surface gravity is so low compared to that of the earth that a man weighing 150 on earth would weigh only about 60 pounds on Mars. The surface area of Mars equals the land area of the earth. About one-tenth of the land area of the earth is desert. (Continued on page 106)

Aurora Borealis

By PAULINE STARKWEATHER

Ghosts of old rainbows are abroad tonight;
spirits of long forgotten dawns;
phantoms of light—

There is an amber hope that flickers . . .
and wavers . . . and dies;
there is a clear blue prayer.

Suddenly, out of the stainless north,
a flashing spar
of white faith in the rightness of right
pierces the changeless star.

Low in the east, where midnight still
is black with a million woes,
love, like an ember, glows.

Camera Trails

By EDNA HOFFMAN EVANS

THIS is not going to be a success story. There are more failures in it than successes, but that is the way learning is acquired.

It is discouraging, sometimes, for the beginning Nature photographer to see the published successes of experts. "Don't they ever fail," he wonders. "Are all their pictures as good as that?"

The answer is no, definitely not. For every one good Nature picture, there are many poor ones. The ratio varies, of course, but few photographic expeditions hope for more than one good shot in ten tries.

Take, for example, the assignment I gave myself recently. It grew out of the days when I was a newspaper reporter and got all sorts of odd assignments. I had to go to a lot of different places, ask a great variety of questions, write all kinds of stories, and interview many types of people. Occasionally, I even had to interview animals.

Two four-footed interviewees stand out in my memory—both of them were dogs. One was an elderly, shaggy mongrel that had just inherited $25,000. The other was a pert terrier, the veteran of fifty B-17 missions over Germany. It was fun to write their stories.

I always hoped some day the editor would send me out to the zoo to interview the animals there—in fact, I suggested it several times. But the editor was not fond of animals and the idea did not appeal.

Now that I am able to tack the title of "Photograph Editor" after my own name, I decided the other day to give myself that assignment, and to use it as a "Camera Trails" section. I had never visited that particular zoo before (it is in Houston, Texas) and I had no idea what sort of subjects or what kind of photographic conditions I would find.

The day, like so many winter ones in the Lone Star State, was damp, chill, and only a small patch of blue sky could be seen through the gray cloud mass overhead. The light was bad, but it was the best we had had for a week. If the animals felt the chill and the dampness half as much as this misplaced Floridian, they all probably were homesick for Africa, tropical America, or wherever home happened to be. They certainly were not in any mood for posing.

A cooperative spotted fallow deer and family. This picture was taken through a wire mesh and focusing eliminated all traces of the wire.

I arrived with only my normal lens, an f4.5 Zeiss-Tessar but, after a preliminary look around, I decided I needed my telephoto. The animals in enclosures light enough to permit photography on that dull day were staying too far away from the fence to permit ordinary close-ups. So, off I went to get the telephoto. This took three-quarters of an hour.

Houston, Texas, is a growing city. It has grown so fast that even the natives have to find their way around with a map. The present zoo is all right for a small town—the cages are clean and the animals look healthy. But, for the big city that Houston has become, the zoo is smallish and antiquated. Plans are under way, however, for a big new layout, with fenceless cages and new collections of animals. Some day Houston may have a super-zoo, just as its boosters plan to have a super-everything else.

But, unless "Camera Trails" readers have access to one of the big modern zoos, the difficulties I met in filling my self-made assignment may be more useful than if all conditions had been perfect. I learned a lot from my failures.

It was feeding time in lion row. The big cats were pacing restlessly behind the bars of their small cement cages. One lioness with three cubs snarled and clawed at the door when the keeper pushed in a chunk of hair, hide and meat. Then she and the cubs settled down, more or less amicably, to eat. It would have been a nice picture, if I could have made it. As it was, I did not waste the film.

Why? First, because the heavy bars interfered. Second, because it was impossible to lift the Graflex high enough to get any foreground in the picture. (The nearby owner of a miniature camera had the advantage there for she could snap pictures from eye-level while I had to hold the Graflex against my midriff.) Third, there were too many spectators around and too little elbow room for maneuvering. Fourth, the image I saw in the ground glass was dull, uninteresting and, focus as I would, some part of it was always fuzzy. So, chalk up one failure at the lion cages.

What was true of the lions was true with every other animal housed in a small, barred cage. That included the tigers, leopards, bears, foxes, raccoons, coatis, hyenas, wolves, dingoes and others. Even the wrinkled-faced, baby rhesus monkey clinging to his mother did not look appealing through the bars.

The birds, too, were not in the mood to be photographed. The ostrich turned his back and stalked into his shelter. The razor-billed curassow insisted on coming too close. The marabou stork sulked in a corner. Even the (Continued on page 106)

This zebra picture was shot at 1/235th with a telephoto lens. Lack of light prevented a faster shutter speed so not all motion is stopped. The lens was focused and the picture made when the animal galloped into place. This is not a good picture, but it shows what can be done, given better photographic working conditions.

The School Page

By E. LAURENCE PALMER

Professor of Nature and Science Education, Cornell University, and Director of Nature Education, The American Nature Association

ORTHOPTERA IN SCHOOL

"Grasshoppers may be distinguished from other insects by a large pair of jumping legs". According to the dictionary, the name "grasshopper" is properly applied to any of the jumping insects belonging to the families Acridiidae and Locustidae. This leaves out the crickets of the family Gryllidae and the mantids of the family Mantidae. Certainly, crickets and mantids have a large pair of jumping legs, and if anyone does not think that the fleas have good pairs of jumping legs, then they do not know their fleas. To anyone who knows anything about insects, grasshoppers can *not* be distinguished from other insects because they have large pairs of jumping legs.

The statement quoted above appears as item 15 in Form R-1 of the Dvorak General Science Scale, published originally in 1924 and still available for sale. It is representative of a goodly proportion of the units in this test, which was the instrument of measurement used in studies recommended as valid in the thirty-first Yearbook of the National Society for the Study of Education, and again quoted as valid on pages 59, 150 and elsewhere of the current forty-sixth yearbook of the same organization. Since this brilliant unit in a widely and long-used test seems to have the sanction of most of those in high places in the field of science education, it might not be out of order to give a little study to these animals, even at this time of the year. Certainly, a large pair of jumping legs does not distinguish the grasshoppers from other insects in spite of the fact that many a child of intelligence may have received a lowering in his grade by contending that this character is not definitive. The testers cannot be wrong, you know.

Incidentally, if you knuckle under and agree with the testers in answering the above stated unit as they suggest, then you are satisfying "one or more of the Seven Cardinal Principles of Secondary Education," since no unit was included that did not have this quality. Some time I should like to ask those testers which of those principles were satisfied by a few of the absurd units found in the test.

Apparently some of these science education people think that truth in science can be established by debate. Today, I received a letter from a student in a school where one of the leading science educators never had a college course in science in his life, and it is a major university at that. The student writes that his "statement that the textbook approach to Nature is relatively ineffective in arousing and maintaining an abiding interest in Nature has been questioned." He asked me to supply him with some effective arguments. Now what would you do in a case like that? It strikes me that the whole idea of a debate on such a subject, judged by a man who never had a college course in science, would be wholly futile. Any decision reached could not be safely applied to all children, at all times, in all places, on all matters. It is about in the class with a debate I entered in my high school days as to whether the national pie should be the mince pie or the apple pie.

But now what can we do about these orthoptera in school? Most schools can find some examples of the animals at any time of the year. Cockroaches are present if crickets are not available, and, even if they are not common, mantid egg masses may be found outdoors in the dead of winter in the proper range. Unfortunately, the eggs will hatch if brought into the warm indoors, but the animals can at least be studied for a while, and a good demonstration may be made of what often happens when man sets about to make Nature behave for him.

I rather think that one of the first steps in studying orthoptera in school would be to make representative local collections. From a study of the living animals, a group of characters could be evolved that might be helpful in classifying other possible candidates for inclusion. True, many of the animals have a pair of jumping feet, but this is not enough to characterize all or to exclude all. They have chewing mouth parts, but so do members of some other groups of insects. They have an incomplete metamorphosis, but this is not a character that makes them unique. If they have wings, the wings are usually straight (hence the name ortho, or straight; ptera, wing). But just to classify them is not all we should do with these animals in school.

We can rear them, experimenting to see what they will eat and what they reject. We can try different insect repellents and poisons to see which affect them and how. We can pry into their private lives if we keep them in vivaria, and learn which favor dryness and which do better in moist environments. We can, possibly, get some idea of their reproductive stories and of their enemies. Most of these studies may be engineered by the merest tyro willing to take the trouble to put like animals in unlike surroundings, and patient enough to see what differences in behavior seem to result.

In spite of what I wrote earlier, I would not decry the use of printed material to supplement original observation. And since this is the case, any good school interested in the study of local orthoptera will want to write to the state agricultural experiment station for suggestions as to local problems and how they may be solved. This idea, of course, may be expanded to consulting national sources of information. The United States Department of Agriculture has some excellent general references in its farmers' bulletins. The Smithsonian has published some excellent short papers on how some orthoptera produce their sounds, and magazines of national significance such as *Nature Magazine, Natural History, The National Geographic,* and others, rather regularly give some member of the group a leading feature article.

Schools addicted to the habit of having Nature calendars, either as posters or as class diaries, will find a most interesting field of exploration if they will record therein "firsts" for the

Fraidy-Cat

By JOHN GALLINARI WHIDDING

Now, cricket, have no fear of me!
Play on—play long.
Don't question my integrity—
I like your song!

You fiddle for some fairy dance
It seems to me
And, thinking to observe such chance
Festivity,

I often come too near some leaf
On which you sit—
And then, to my indignant grief,
You promptly quit.

If I should come too close again,
Don't be so scared!
I have my faults (like other men)
But, if I dared,

I'd play the summer night away
The same as you.
(In spite of what my neighbors say,
I often do!)

So, cricket-fiddler—fraidy-cat!—
Forgive my sin
And do not mute your slightly flat
Quaint violin.

orthoptera as they carry on their seasonal activities. When does the first cricket call, the first grasshopper buzz, the first katydid argue? When do each of these sign off for the year, and what climatic conditions can be recorded as being contemporary and possibly significant?

Those who may be literarily minded may wish to read what others have written about what they saw orthoptera do. These must by all means read "The Life of the Grasshopper" by Fabre, and note the inclusion in the volume of insects that are not orthoptera but which have been associated with them because of popular misconceptions as to what a "locust" is, for example. This little book should lead into all sorts of interesting ramifications that will appeal to the alert teacher. What is a locust to the botanist, to the entomologist, to the poet, and to the everyday man? Can we safely attribute to all locusts the properties we recognize in one? How many times can we find that failure to define in this field has led to ridiculous generalization?

Social science teachers will find in their history books plenty of reference to the contributions orthopterans have made and are making to famine and tragedy. The history of our own country presents us with some interesting details, and the fact that our modern methods of farming have created conditions that have restrained the destructive effect of these insects should not be overlooked. Writers of novels have often fallen back on locust plagues to give them a setting for dramatic incidents, and the movie script writers have not failed to join the parade in the same area. Not infrequently the novelists have let their imaginations run away with them, but since a grasshopper in a novel can do no one any harm we can well overlook this matter.

The physics teachers have now and then attempted to teach an understanding of the ability of the leaping orthoptera to excel in their particular field. They have pointed to the relationships that may be obvious between structure and function. Some have attempted to draw comparisons as to the proportionate distance animals of our weight would have to jump if we had the skill of grasshoppers as saltatorial animals. The physics teacher may also find some opportunity for worthwhile study in considering the stridulating orthopterans to determine at what pitch their sounds are produced. It is perfectly obvious that many of the sounds produced by these insects are beyond the range of our hearing, but just where does this limit go? The psychologists will want to tell us to avoid assuming that a singing orthopteran is singing a love song and not damning a rival. The cartoonist will find in the poker faces of these animals suggestions that are worth recognizing. And so the story goes. These animals should be known better.

Are Birds Ever Luminous?

Luminosity among lower organisms is so well-known as to have become a part of common knowledge. Bacteria, one-celled animals of the sea, certainly jelly fishes, crustaceans, worms, squids, fishes, centipedes, and beetles (fire-flies) have the power of emitting light.

The higher vertebrates—as mammals and birds—however, seem not to share this faculty, although red or light-reflecting eyes and iridescent plumages have given rise to uncritical reports of luminosity. Still, for birds, there remain accounts of luminous owls and herons that can not so easily be explained away. Barn owls with phosphorescent feathers have been observed in various countries, most commonly, at least according to the records, in England. The cause, it has been conjectured, is that the birds have become smeared in the tree cavities they frequent with light-giving fungi.

The glow, often reported coming from the breasts of herons, has been thought to aid them in fishing by night. No part of this phenomenon has been established by scientific observation and tests for light-producing qualities of the birds have been negative. Yet the records are numerous and some at least of their proposers saw something. The present state of the matter appears to be that certain birds are sometimes luminous but not from their own properties. The presence among their own feathers of light-giving fungi or bacteria has been suggested as a possible explanation of the reported instances. Scientists should continue investigation in this field.—W. L. M.

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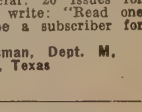

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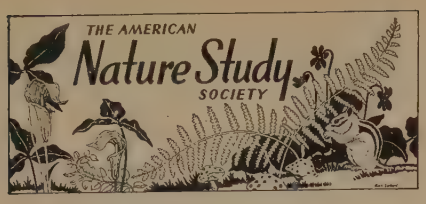

CONSERVATION EDUCATION MOVES AHEAD

By Richard L. Weaver
Program Director
North Carolina Resource-Use Education Commission; Secretary, A.N.S.S.

Naturalists, foresters, soil scientists, wildlife managers, biologists, and some educators informally inaugurated the Conservation Education movement throughout the 1930's. Much of the pioneer work evolved through efforts on the part of these technically-trained scientists to interest the laymen in the technique of managing a particular resource: forests, wildlife, soils, water or minerals.

In Michigan and Ohio the Department of Conservation subsidized and guided the program in the schools through underwriting a supervisor. Virginia Department of Education has a supervisor of conservation studies. In Tennessee, Missouri, West Virginia, Pennsylvania, strong state programs were developed, largely by the staff of the conservation departments. Since 1929, Arkansas, Florida, Georgia, Kentucky, Maryland, North Dakota, Oklahoma, and Wisconsin have enacted state legislation requiring the teaching of conservation in the schools, and some materials have been prepared.

Michigan has trained many teachers in conservation education through short courses at state-owned centers, where students from teachers' colleges receive instruction from specialists in wildlife, forestry, agriculture, of the state agencies. Extended field trips by bus are also used to visit various demonstrations of wise land-use. Many educators and scientists served on committees to prepare several excellent guides for the use of teachers.

Wisconsin prepared three handbooks on conservation education to assist their teachers in carrying out the provisions of their state law. West Virginia published two guides for grades 1-6, 7-12. Missouri published a series of leaflets prepared by the staff of the Department of Conservation, which have been used widely in the schools.

The Pennsylvania Game Commission supplies lectures and many printed materials to the schools. The Tennessee Department of Conservation organized a series of demonstration schools in the late 1930's and supplied them with staff assistance, printed and visual aids. The Department also encouraged the teacher-training institutions to include courses in conservation and summer school workshops on conservation in their program.

Arkansas Department of Education published a very comprehensive summary of its natural resources in 1942. Kentucky prepared a similar volume in 1942, and another one in 1945.

Florida Department of Public Instruction prepared units of study to assist its teachers to comply with its new legislation in the 1930's. In 1947 "Florida Wealth or Waste" was prepared for use in the ninth grade, by the State Committee on Resource-Use Education.

New York, not having legislation requiring the teaching of conservation or the leadership in any of the state departments until 1946, relied heavily on the series of Cornell Rural School Leaflets published and edited at Cornell University for the past fifty years. Many of these were devoted exclusively to soils, forests, wildlife, minerals, while others suggested means for including Nature and conservation in the school curriculum. In 1946, the Department of Conservation of New York organized a Division of Education, and is now preparing materials and offering effective leadership in conservation education.

California and Iowa patterned a series of leaflets after those of Cornell, which have been widely used in school programs. Indiana is preparing a series of guides on soil, water, forests, and wildlife. South Carolina, Illinois, and many other states have recently prepared special bulletins on soil and water conservation in cooperation with the U. S. Soil Conservation Service. New Hampshire, New Jersey and others have specialized in conservation week bulletins prepared cooperatively with the state and national garden club groups.

Ohio, Tennessee, Rhode Island, Michigan and New Hampshire have held some of the first summer school programs designated as conservation laboratories, workshops, or camps. These began in the middle thirties. Ohio has held five-week camps each year, attended by 30 to 40 teachers. This program is cooperatively sponsored by Ohio State University, the Ohio Department of Education, and the Ohio Dept. of Conservation. Rhode Island and Michigan have specialized in one and two-week workshops. New Hampshire and Tennessee held workshops in teacher-training institutions but these were interrupted by the war. In New Hampshire the program was reestablished in 1947 in cooperation with Columbia University.

New Jersey and Pennsylvania organized summer laboratories in 1946 for the first time. Two sessions of three weeks each are held in Pennsylvania for seventy teachers who are given liberal scholarships by interested organizations in the state. The laboratory is held at the Pennsylvania State College in cooperation with the Pennsylvania Department of Public Instruction. Michigan has now patterned a scholarship camp after the one in Pennsylvania. New Jersey has a shorter workshop at a teacher-training institution.

Illinois held its first conservation workshop in 1947, as a cooperative enterprise between the University of Illinois and the Illinois Department of Education. West Virginia held its first conservation camp in 1945 at Jackson Mills, a state-owned camp, and has continued three-week sessions each year. The West Virginia State Department of Education and five teacher-training institutions sponsor the camp. The Audubon Nature Center at Greenwich, Conn., and the Connecticut State College organized workshops in 1946.

Virginia held three-week conservation workshops at five teacher-training institutions in 1945, 1946 and 1947, supervised largely by a supervisor of conservation studies in the Department of Education and partially financed by funds from a foundation.

These summer workshops and laboratories, while held in atmospheres similar to the earlier Nature camps held at Pennsylvania State College, Pa.; Western Reserve, Ohio; Alleghany State Forest, New York; Lost River, New Hampshire; Audubon Nature Camp, Maine, emphasize the techniques of management of our natural resources as well as a recognition of the trees, birds, mammals, soils, fish, marine life, and other objects of Nature, so common among Nature camps.

The methods for adapting the information to the present school curriculum are emphasized to a greater extent in present-day programs. Field trips, outdoor experiments, and individual preparation of programs are features in common between the earlier nature camps and the present-day workshops or laboratories.

In such areas as the TVA where conservation of natural resources could only be developed by a widespread acceptance of the concept of unified development—increasing the potentiality of people and social agencies so as to use the natural resources more effectively, a new philosophy of use has emerged. This, while not greatly at variance with conservation education, stresses the importance of the human and social elements, and emphasizes maximum use in contrast to the more protective features and limited viewpoint of the term "conservation." In fact, in most programs of conservation education the field of human resources is purposely omitted entirely.

Another important difference exists in the leadership of the two programs. Whereas much of the guidance in conservation education has come from naturalists, biologists, foresters and soil technicians, the leadership in resource-use has developed in the educational agencies where educators and social scientists and technicians have worked together in utilizing the information available and interesting school people in the use of such knowledge.

DIG IN FOR FRIENDSHIP

(Continued from page 92)

are scarce and dear, perhaps there is some excuse for this, but when you can replenish the supply without cost from your own garden there is no reason to save things that have passed their prime. If your crops ripen faster than you can eat or preserve them by canning or freezing, give them to your friends. Food is too precious these days to waste.

Any way you consider it, growing a garden this year will be a thrifty and a mighty satisfying family project. You will save money on your food bill, save meat and grain for shipment overseas, and it may save you something in doctor's bills and recreational expense. The only way you can lose will be possibly something off your waistline. And a good many of us older folks can stand that!

Conservation at Lehigh

Starting in the spring of this year, classes will start at Lehigh University in a new undergraduate arts-science major sequence in conservation, according to an announcement by Dr. Philip M. Palmer, dean of the College of Arts and Sciences. The scope of the new program is to provide a well-rounded undergraduate training in the economic, social and scientific aspects of natural resources. There will be no specialization, which would come in graduate schools, and the four-year course will be devoted to basic studies leading to an understanding of conservation in all fields. Dr. Francis J. Trembley, associate professor of biology, built the new curriculum through a faculty committee and consultation with more than fifty of the nation's leading conservationists. The curriculum will be offered jointly by the departments of biology and geology, and there will be a great deal of field work, which Dr. Trembley promises will be hard work.

New Magazine

Pacific Discovery is the name of a new bi-monthly magazine published by The California Academy of Sciences. According to announcement by Dr. Robert C. Miller, Director of the Academy and managing editor of the new publication, it will be a popular journal of Nature and man in the Pacific World. The editor and art editor is Don Greame Kelley, and associate editors are Dr. Wilbert M. Chapman, Dr. John L. Kask, Dr. A. Starker Leopold, Dr. Robert T Orr, Dr. Edward S. Ross and Dr. Ira L. Wiggins. The magazine, which made its bow with the January-February issue, will go without additional charge to members of the Academy; to others the subscription rate is three dollars a year.

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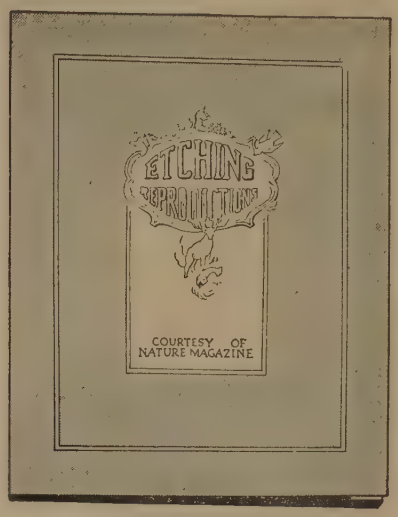

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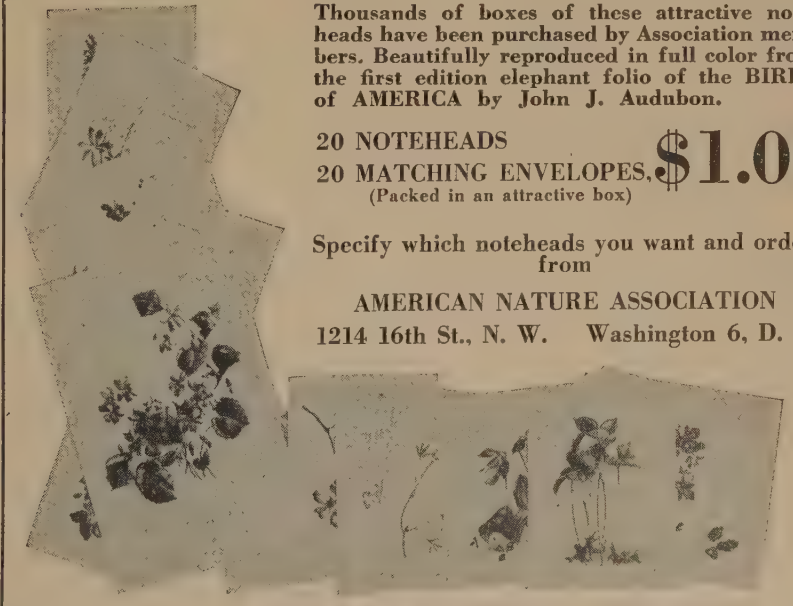

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CAMERA TRAILS

(Continued from page 101)

peacocks veered off whenever I pointed my lens at them (I was not much interested in peacocks, anyhow). The flamingos and egrets made an attractive group, standing in their pool with the water reflecting their colors. There was plenty of light in that cage, and room to maneuver. Still, I had to chalk up another failure. This time it was because of the background. No matter what angle I tried, it was impossible to dodge at least two of the iron cage supports. Whoever designed that cage intended it to stand, but he certainly did not take the needs of visiting photographers into consideration.

The peccaries from tropical America, and their big-snouted European boar cousins, were friendly enough, bringing their muddy selves close to the cage wires in order to see what it was all about. But the tree-shaded pen was too dark, and the doubly reenforced wires around it too close together. No pig pictures, either.

The zebras were wild. They had a nice big enclosure and they insisted on staying at the far end of it. But, after a time, they took to galloping up and down the farthest fence. They followed a set pattern, and, after watching them for some time, I found I could anticipate their movements. Thus, I focused on a particular spot and waited until they galloped into it. The result was not too bad, and would have been better if the light had permitted more than the 1/235th second shutter speed that I used. The zebras, definitely, will offer more possibilities on a sunny day.

That left the deer enclosures, and, bless them, the deer were willing to cooperate. Several bucks had fine sets of antlers and they waited patiently while I maneuvered. The telephoto brought them close enough, the background went obligingly out of focus, and the light was not too bad for some lens stopping.

I shot directly through the wire fence without paying any attention to the location of the mesh. The resulting picture, used as an illustration, came out as clear as though there had been no wire between me and the deer. The lens, properly focused, took care of that. I have known this fact for a long time, nevertheless, whenever I shoot through a wire fence and find the wire makes no appearance in the resulting picture, I am impressed all over again. It must be done right, however. If the camera is too far from the mesh, or the subject too close, the wire shows up. But, when the camera is close and the subject is thirty or forty feet away, there is no fence interference.

Of course, not all the deer pictures came out well. The one I counted on most, a perfectly poised shot of a brown fallow deer, was underexposed. The negative was too thin for successful printing, although the dim image on it fairly made my photographic mouth water. If only the light had been better, or the shutter speed slower, or the film faster —but that is photography. If every picture came out perfectly, what fun would there be in taking them?

I am going back to the zoo for more pictures, and I intend to profit by my original mistakes. To that end, I have drawn up a list of do's and don'ts for myself. They follow:

1. Do take all your equipment the first time. You may not need it but, if you do, you will not waste time going home after it.

2. Do pick a better time of the year than winter unless, of course, you would rather use your summer days in the wilds.

3. Do plan your time so you can wait for an animal to assume the pose you want. It will, eventually, but you may have a long wait.

4. Don't go when there are a lot of people around. Morning is the best time while week-ends and holidays should be avoided.

5. Don't expect immediate success. A preliminary visit to get the lay of the land will save time and steps when you are loaded down with camera, tripod and other equipment.

6. Don't waste time at the small barred cages, unless all you want is a picture of the cage with a blur inside.

NEW BOOK; NO MAIL

I found a new book the other day, at least it was new to me, although the fourth edition of it appeared in August of 1944. It is *Nature and Camera* by Oliver G. Pike, an English Nature photographer. The small volume sums up the author's fifty years of experience in photographing flora and fauna in the British Isles, and it is worth inclusion in any Nature photographer's library. Published by the Focal Press of London and New York, it sells for $3.95.

The mailman has brought few trade items this month, probably because of the post-Christmas let-down on the part of manufacturers. There was a slack period at this time last year, too. But there will be more next month, I hope.

Profit from Woodlands

"Managing Small Woodlands" is the title of a practical new book issued by the American Forestry Association, 919 17th Street, N.W., Washington 6, D. C. It is a guide to good and profitable use of forest land, and tells, step by step, how farmers and other owners of small timber tracts can grow and harvest repeated crops of pulpwood, ties, sawlogs, poles and bolts for market and home use. The authors are A. Keroleff and J. A. Fitzwater, both foresters. The price is one dollar.

DOES LIFE EXIST ON MARS?

(Continued from page 100)

On Mars more than half of the surface area is a desert region, giving the planet its deeply reddish tinge. There are apparently no oceans or lakes. There are, however, dark greenish or bluish-gray regions that cover about three-eighths of the surface. These regions change in color with the Martian seasons—which are very similar to our own although nearly twice as long—darkening with the coming of spring and the melting of the white polar cap. White areas, apparently consisting of clouds, hoar frost, or haze, come and go transiently over the surface. The canals have been traced by many observers across the reddish as well as dark regions of the planet, criss-crossing the surface in all directions, and a number of them meeting in the dark spots called oases, which may be as much as 100 miles across. Doubling of the canals in some instances has been noted. Such canals appear as fine lines 100 or 200 miles apart and equidistant their entire length.

The atmosphere of Mars is, to be sure, much less dense than our own, but, nevertheless, an atmosphere does exist on this planet and it does contain both oxygen and carbon dioxide, and no poisonous gases such as exist on the outer planets. It has been found that the atmospheric temperature at the equator of the planet is about like that of a spring day on the earth in mid-latitudes. When one considers all of these facts, as well as the nature of the surface markings on the planet, the seasonal changes and length of day, so similar to that of our own planet, one finds it difficult to escape from the belief that life must exist on this other world.

The planet Saturn, as well as Mars, will be in opposition to the sun this month. Saturn is now in Leo, a few degrees west of Regulus, and, at the beginning of the month, Mars is about equally far to the east of Regulus, in Leo. The two planets will draw closer together as the month advances. Saturn is now about as brilliant as Vega, but Mars, now at its brightest, is about equal to Canopus in brilliance throughout the month. Saturn will be in opposition and visible all night on February 9. Mercury will be at greatest elongation east of the sun on February 4, and this is the most favorable time of the year to see it in the evening sky. It should be visible in the evening twilight for a week or ten days the first of the month, and should be a little south of west. It will be more brilliant than Vega or Capella when at elongation.

Venus is now in the western sky in the early evening and is drawing away from the sun and improving its position gradually. Jupiter is now visible in the eastern sky before sunrise in the constellation of Ophiuchus until the end of the month, when it passes into Sagittarius.

THE READER'S MARKET

A place where members of the American Nature Association and readers of Nature Magazine may find many interesting offerings or may advertise themselves, at low cost, for things wanted; things they have for Sale, for Trade, for Sale or Trade. This is an excellent forum for acquiring or disposing of such items as binoculars, books, cameras and photographic equipment, magazines, sports and outdoor equipment, etc.

GENERAL REQUIREMENTS APPLICABLE TO CLASSIFIED ADVERTISING

1. *Transactions based on good faith:* Transactions are based on good faith and mutual satisfaction. Deliberate misrepresentation, disregard of usual business ethics or the attempt to circumvent these general requirements, when brought to our attention, will result in refusal of further advertising.

2. *All orders subject to these conditions:* We reserve the right to edit all copy to conform with our standards and to reject or discontinue any advertisement which we consider undesirable.

3. *Who may advertise:* This department is an open market trading post. Any individual or firm whose advertisement and methods of doing business meet our requirements may advertise their goods or services.

4. *Rates:* All classified advertisements must be accompanied by remittance. The rate is 15c per word including name and address—minimum charge $2.00. Cash with order.

5. *How to count numerals etc.:* Groups of figures are counted as one word. Abbreviations consisting of initials or single characters likewise are counted as one word. Hyphenated words are counted as two words.

6. *"For Sale" ads must state prices:* A specific price must be stated on all FOR SALE ads —except that the phrase "write for catalog" may be used when listing real estate or merchandise in quantities.

7. *Conditions of trade or sale:* The condition of binoculars, cameras, instruments, other equipment useful to outdoor lovers, home-owners, etc., advertised for sale or trade must be specified as follows: PERFECT—meaning factory condition; EXCELLENT—meaning new condition, implying negligible amount of use; VERY GOOD—meaning practically new condition, implying little use, with no appreciable wear and only minor surface scratches or wear; GOOD—meaning moderate condition and with only moderate wear; FAIR—meaning no parts missing necessary to use, reasonable wear inside and out; POOR—meaning marred appearance or badly worn.

8. *Non-specific phrases barred:* Phrases such as "highest" or "top prices paid", as well as any other so-called "auction-type" phrases are not acceptable. The terms "fair price paid" or "state price wanted" may be used.

9. *Blind ads not acceptable:* Box number or blind ads will not be accepted. Give your complete name and address to insure prompt delivery of all mail or telegraph replies.

10. *Requesting privilege of examination:* Purchasers desirous of examining merchandise before acceptance should request shipment by express C. O. D. with examination privilege. This procedure permits the purchaser to inspect the merchandise in local express office and authorizes the express company to return unsatisfactory merchandise at shipper's expense.

11. The association will not accept for publication in NATURE MAGAZINE, advertisements of firearms ammunition, or patent medicines.

12. *Responsibility for illegible copy:* Type or print advertisement plainly as we cannot be responsible for errors due to illegible writing.

13. *Closing date:* The closing date of all advertisements is the 20th of the second month preceding month of issue.

ANTIQUES GLASS FOR SALE

MOON AND STAR: List for stamp. Forrest Sowers; Doylestown, Penna.

BIOLOGICAL SUPPLIES

FEDERAL STANDARD SIZE MICROSCOPE $59.00; prospectus free. Tripod magnifier $1.35. Ten gallon aquarium $5.30. New School and Hobby Catalogue 10¢. Quivira Specialties, Topeka, Kan.

BIRDS

CANARIES AT WORK and Play; new book; training, care and fun. $2.50. Free Circular. Wetzel Publishing Co., 524 So. Spring St., Los Angeles 13, California.

BOOKS

NATURE LOVERS' LIBRARY—6 volumes 8½x11, 2000 pages, weight 23 lbs.; lives and habits 3000 species birds and animals described by renowned Naturalists; 1000 species illustrated, 300 in color. The Literary Mart, 8 East 33rd St., New York, offers this set to members for $29.50 payable $4.50 with order, $5.00 monthly; full refund for return in 5 days.

ADVENTURES IN WILD KNOWLEDGE! Exciting new trails to outdoor science. Adapted to schools, scouts, summer camps. Free samples. Naturegraph Company, 225 Main St., Los Altos, Cal.

"EVOLUTION and the Blood Precipitation Test," 25¢. Christian Evidence League, Malverne, N. Y.

BOOKFINDERS! (scarce, out-of-print, unusual books) Quickly supplied. Send wants. Clifton, Box 1377nm, Beverly Hills, Calif.

"THE CASE FOR CREATION," 85¢. Christian Evidence League, Malverne, N. Y.

ANGLING, HUNTING, and NATURE books, new, used and rare. Request free list. Sporting Book Service, Dept. D, Rancocas, N. J.

FLOWER LOVERS—Join the Bulb of the Month Club—send today for free copy of "How to Grow 12 Rare Flowering Bulbs in Your Home." Send 12¢ stamps or coin to cover handling. You will receive full details of Club and invitation to membership. Bulb of the Month Club—P. O. Box 54, Algonquin, Illinois.

BOOKS! Hard-to-find and out-of-print our specialty; All subjects. Send Wants! Jaher Book Service, 620-N East 178th St., New York 57.

BUTTERFLIES

BUTTERFLIES: 15 U. S. named, including Zebra $2.00; 15 Mexican including Calico $2.00; 15 Amazon beauties including Blue Morpho $2.00. M. Spelman, 2781 Grand Concourse, New York 58, N. Y.

LIVING COCOONS of Silk Moths; 15 for $1.00. Living Praying Mantis Egg Masses for control of insects; 12 for $1.00. North and South American Butterflies and moths; 12 for $1.50. Postage extra. Dr. R. Miller, Box 47, station "E," Brooklyn 7, New York.

DOGS

PUREBRED, PEDIGREED COLLIE puppies, healthy, lovely. Geo. McDowell, Dimondale, Michigan.

REGISTERED Redbone and Blacktan coonhound pups. Parents A-1 cooners. Illustrated folder, 25¢. W. B. Frisbee, R-1, Clarence, Missouri.

REGISTERED long eared black and tan fox and coonhound pups. Royce Coon, Ghent, New York.

FIELD GLASSES

TELESCOPES, BINOCULARS, Microscopes—big bargain, catalog free. Brownscope Company, 24 West 45th St., New York.

HOBBIES

EARTHWORM CULTURE. A fascinating hobby; profitable home industry. Write for valuable free bulletin-review on "Earthworms: Their Intensive Propagation and Use."—Thomas J. Barrett, Earthmaster Farms, Box D-488, Roscoe, California.

YOU CAN ENTERTAIN with chalk talks. Catalog 10¢. J. G. Balda, Cartoonist, Oshkosh, Wis.

HOMECRAFTSMAN

LEATHER AND METAL CRAFTERS! Fine leathers, tools, accessories; tooling metals and supplies. Free catalogs. Kit Kraft, Dept. NA, 3203 W. Washington Blvd., Los Angeles 16, Calif.

MAKE-IT-YOURSELF

WHITTLER'S—Supplies—blanks—special woods—knives. "Old" Whittler, 1402 Charles St., La Crosse, Wis.

EASTER EGG DECORATIONS. To make eggs look like heads. Bunny, Duck, Kitten, Humpty Dumpty, Angel. Each 10¢. F. W. Williams, 3743 Evans Avenue, St. Louis, Missouri.

MINERALS

"ROMANCE IN STONES." Arizona rare minerals. Collectors or museum grade, 12 miniatures, assorted, colorful, brilliant, genuinely rare, $3. Sam Parker, 620 North Third St., Phoenix, Arizona.

MISCELLANEOUS

MEXICAN MANTILLAS (Head Shawls). Universally worn by Mexican women in daily shopping or Easter bonnets. Six feet long, two feet wide. Black. Sample $1.25, dozen $12.00. Mexican Products Co., 126 North Main, Tulsa 3, Okla.

PLANTS

WILD FLOWERS and FERNS to brighten a shady nook. Free Booklet. Wake Robin Farm, R. D., Home, Pennsylvania.

We Ship GROWING REDWOOD BURLS from the world's oldest living trees. Sprout delicate fernlike leaves. $1.00 to $5.00 sizes. Bullock, South Fork, Calif.

NATIVE WILD FLOWERS—shrubs, trees, ferns, vines, rhododendrons-azaleas. Free catalogue. Three Laurels, Marshall, N. C.

POEMS WANTED

POEMS WANTED FOR MUSICAL SETTING. Send poems for immediate consideration. Hamann Service, 590 Manhattan Building, Milwaukee, Wisc.

POULTRY & SUPPLIES

RAISE FRYERS new easy way. $6000 yearly possible in your backyard. Booklet FREE. Poultry Guild, 1046-K So. Olive, Los Angeles 15, California.

PRINTING

PRINTING MACHINERY, Type, Supplies. Lists 3¢. Turnbaugh Service, Loysville, Penna.

SEA SHELLS

SHELLS FOR SALE. Land and Marine; Cape Cod. Special 12 for $1.00 in box; Lists on request. Mrs. F. K. Hadley, Box 33, West Newton, Mass.

CHINESE SYMBOLISM

(Continued from page 96)

mortality, and, having swallowed it, she flew to the moon. It seems that she had an attack of coughing and brought up the pill, whereupon its covering was transformed into the Moon Hare.

One of the most important feast days on the entire calendar is the Moon Festival, which occurs annually on the fifteenth of the eighth Chinese moon. As the day approaches, little clay figures of the Moon Hare are prominently displayed in all North China street and temple markets to tempt shoppers who are making preparations for this special occasion. When the day arrives there are set up in the majority of the courtyards in China open-air altars upon which are placed five plates of fruit—each variety being round and thereby resembling the full moon. The chief offering, however, is the plate of thirteen *yüeh-ping*, "moon-cakes"—one for each month of the Chinese year. These "moon-cakes," decorated with the likeness of the Moon Hare and filled with a stuffing of melon seeds, orange peel, spices, sugar, and almonds, are as essential to the Chinese on the Moon Festival as Easter eggs and English plum puddings are in their respective seasons in other places. After the full moon—the Harvest Moon—has risen, there is a brief ceremony that includes the lighting of candles and incense, and, finally, the burning of a brightly colored picture of the Moon Hare.

The beautiful spotted deer, *Cervus mandarinus*, and the Manchurian crane, *Grus japonensis*, make a team of especially outstanding long-life emblems. Both are reputed to reach a fabulous age, the crane, in particular, being supposed to drink, but not to eat, after it has passed the 600-year mark.

In Chinese paintings the God of Long Life frequently has as his companions both the deer and the crane. This same pair of longevity symbols appear on the lids of handsome pewter dishes that are appropriately used at birthday feasts. Under strikingly different circumstances the deer and the crane are seen going side by side—life-sized figures of them being borne in funeral processions. These figures, constructed of a framework of *kaoliang* stalks and covered with paper or arbor-vitae, are carried to the burial place and there burned. In connection with the crane there is the hope that the departed spirit may ride it to heaven, even as many of the Taoist divinities are supposed to employ it on their aerial journeys.

Often, however, the deer and the crane are quite independent of one another.

The common Chinese name of *Cervus mandarinus* is *mei-hua lu*, "plum-blossom deer"—a metaphoric allusion to its white spots. Formerly it doubtless roved over much of northeastern China, but in the present century it has been seen only in areas to the east and northeast of Peiping. Up to the time of the Japanese invasion it was protected in the Imperial Hunting Park at Jehol, where it roamed in large numbers over the hills and seemed to lead an unperturbed existence with no experience of fear.

In the arts and crafts, representations of the deer reflect the traditions of the country. It is believed that the deer is the only animal that can find the sacred fungus, *Fomes japonicus*, so artists and craftsmen frequently depict the deer with some of the fungus in its mouth.

The deer of folklore associates not only with Shou Hsing, the God of Longevity, but also with Ma Ku, the female Immortal who is the Goddess of Long Life. Pictures of Ma Ku make suitable birthday gifts for women just as pictures of Shou Hsing are fittingly given to men on their birthdays.

A triad who are often shown together are the Gods of Longevity, Happiness, and Affluence (or Official Pay). The third member of this group may be mounted upon a deer in recognition of the fact that the Chinese characters *lu* for "deer" and *lu* for "emolument" have the same sound. In this trio there need be no difficulty in recognizing the God of Longevity, for the pronounced bump on his high forehead usually provides sufficient identification.

In the vernacular the Manchurian crane is called *hsien ho*, "fairy crane," because of the prevalent idea that it is a servant of the genii. Live birds have been highly valued, and in normal times before the Japanese war a single bird sometimes brought hundreds of dollars.

Fully two thousand years ago the crane was mentioned in the teachings of one of China's philosophers, who passed down to posterity an apt way for saying that everything is suited to its purpose. "A crane's leg may be long, but you cannot make it shorter without misery to the crane."

Cranes, as well as hares and deer, were imprinted on some of the Ch'in-dynasty tomb tiles, which have already been referred to. The designer of those tiles showed childlike naivete in his rendering of the cranes and left nothing at all to our imagination. We can actually see the fish that the birds have just devoured.

In the late 14th century it became the custom for officials to wear mandarin squares on their robes as an indication of rank. For the squares of civil officials different species of birds were designated "to symbolize the literary elegance of their respective wearers." The Manchurian crane was used by those of the highest, or first, rank.

If the Chinese bride's family can afford them, pewter candlesticks make up part of the dowry that is delivered to the bridegroom's home a few days before the wedding. Cranes, because of their symbolic significance, are a popular pattern for such candlesticks. The character *shou*, "long life," may be incorporated in the design, a reiteration of the wish for longevity.

Another type of candlestick shows a crane standing on the back of a tortoise, a group that craftsmen have made in bronze, brass, and jade. From an old legend we learn that Buddha was making an effort to cross a raging stream one stormy night. His devout followers tried to light his way across the swirling waters, but to little avail, for their lanterns were blown out—all except the candle of a poor widow. Just then a crane appeared and, taking her candle in its beak, flew to the middle of the torrent where a tortoise was accommodating enough to rise to the surface and thus afford footing for the crane.

Chinese greeting cards give a clue to the thoughts of the people. Bright red New Year's cards with their decorations of long-life pines and cranes suggest the wish that the recipient may have joy and good luck through many years. In English we speak of the hills as being "everlasting" and "eternal." The same idea is evident on Chinese birthday cards, which say, "Long life like the Southern Mountain." But perhaps the acme of all birthday greetings is reached in the wish, "May your years be those of the tortoise and the crane!"

It is recorded that Emperor Yao (2356 B.C.) said, "Long life involves much that is not pleasant to put up with," and he disclaimed any desire for it. However, his opinion has not been generally held down the centuries, and there is no clearer proof of this fact than we see in the continuous use of Chinese longevity symbols from Nature.

Quotation from the poet Ou-yang Hsui from *Translations from the Chinese* by Arthur Whaley, reprinted by permission of Alfred A. Knopf, Inc. Copyright 1919 by Alfred A. Knopf, Inc.

Mammal Film

Coronet Instructional Films announces the release of a 16 mm., one-reel, sound, color or black and white film entitled "Mammals of the Countryside." It covers the woodchuck, red fox, skunk, mink, opossum, raccoon, muskrat and beaver, studying these animals in terms of their habits, habitat and influence upon the farmer's crops.

ANSWERS TO QUIZ

1. pronghorn; 2. cony; 3. Protozoa, 4. conch; 5. sprout; 6. condor; 7. taproot; 8. falcon; 9. proboscis; 10. zircon; 11. coprose; 12. conifer; 13. Procavia; 14. aconite; 15. Progne; 16. conger; 17. proso; 18. Convolvulus; 19. sprong; 20. Condylura.

Carolina Wren

From Helen Waldron of Toronto, Canada, comes an interesting little bird note about the Carolina wren. She writes:

"For days a mystic song would ring out suddenly from the depths of the wooded ravine. It was most tantalizing as I could not locate the stranger—shy music-maker—with my glasses. I was just about ready to give up when the song burst out again close by from a dense thicket. At last I caught a glimpse of this shy minstrel with music so angelic and so breath-taking. Within a few feet of me he landed on the St. Francis tray; he fluttered around most excitedly, then paused to eat some suet. Yes, it was the Carolina wren! So he was the shy musician, the very fountain of that rich, wild, mystic and elusive song! At last the secret was revealed.

"'How will he ever endure the cold?', I asked myself. But the little chickadees, always certain of a welcome here, and of a satisfying supply of food, were very polite to the little stranger. The tree sparrows, down at the bath, also sang their sweetly melodious notes of welcome. It made one's heart glad to hear such sweet music in November, when all of Nature's world was so quiet."

Great Lakes Fishes

Fishes of the Great Lakes Region. By Carl L. Hubbs and Karl F. Lagler. Bloomfield Hills, Michigan. 1947. Cranbrook Institute of Science. 186 pages. Illustrated in color and black and white with end maps. $3.00.

This guide to the fishes of the Great Lakes Region is intended for fishermen and for amateur and professional ichthyologists, providing information in the distribution, habits and habitats of these fishes. It is an expansion of an earlier work by the same authors and an extremely valuable and useful addition to the excellent list of publications of the Cranbrook Institute.

Trout Fishing

Angler's Choice. Edited by Howard T. Walden, II. New York. 1947. The Macmillan Company. 326 pages. $3.75.

Anglers will delight in this collection of, for the most part, practical fishing articles and stories, gaining both information and vicarious sport from the reading.

Civic Annual

American Planning and Civic Annual. Edited by Harlean James. Washington, D. C., 1947. American Planning and Civic Association. 214 pages. $3.00.

This is the annual record of civic advance in the fields of planning, parks, housing, neighborhood improvement and conservation of natural resources.

Tulip Society

Organization of the National Tulip Society "to stimulate and increase the general interest in the cultivation of the tulip for all people" is announced by Felix R. Tyroler, executive secretary of the new organization. Mrs. J. J. Nicholson of Atlanta, Georgia, is president, and the three vice-presidents are Mrs. Victor Watkins, Holland, Michigan; Miss Margaret Lancaster, Washington, D. C., and John Sherwood, Baltimore, Maryland. Headquarters are at 37 West 43rd Street, New York 18, New York. Lectures will be provided, special awards made, a monthly bulletin, special publications and a yearbook published.

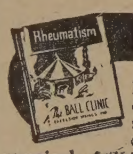
Yellowstone Stories

Yarns of the Yellowstone. By David N. Miles. New York. 1947. The William-Frederick Press. 76 pages. Paper-bound. $1.00.

This is a collection of tales intended for a younger audience and told by and through a garrulous guide named Jim. The stories are, however, based on actual experiences of the author.

Be Kind Week

May 3 to 9 has been set aside as Be Kind to Animals Week, and Humane Sunday is May 9. This is the 34th annual observance conducted under the auspices of the American Humane Association, 135 Washington Avenue, Albany 6, New York. Full information about the week dedicated to humane treatment of animals may be obtained from your local humane association or from the national organization.



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Do you suffer from metatarsal callouses, corns, weak arch foot pains? Try **Dr. Barron's New Foot Cushions. LIKE WALKING ON A PILLOW!** Soft, **Spongy, Air-ventilated.** Fits all shoes. Cushions your **arches** and **feet** from **heel** to **toes.** Dr. Barron says: "Wonderful for tired, aching feet!" Send only $1.98 for **A PAIR,** or C.O.D. plus postage. **State shoe size and if man or woman. 30-DAY TRIAL GUARANTEE.** Money back if no blessed relief.

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REAL SOUTH AMERICAN Chinchillas breeding stock available. Write or visit. Ludwig Acres, Chinchilla Ranch, Box 7, Mohnton, Penna.

5 CENTS DAY starts $1,000 pair Chinchilla ranching. Complete booklet $1.00. Montana Fur Farm, Billings, Montana.

SPORTING GOODS

5000 BARGAINS, Firearms, war relics, binoculars, catalog 40¢. John's Gunshop, Runnemede, New Jersey.

FISHING POLES: Native Canes, Bamboos, supplies. Jointed Native Cane $2.75; steel Rod, Guides, Handle, $2.75; Aluminum Rod, Combination five, Seven or Nine foot rod, three-foot case, Nylon-wrapped Guides, Locking reel seat, finest quality, $6.95. Many other items. Dealers write. Bob Pace, Combs, Arkansas.

TAXIDERMY

GLASS EYES. Made in OUR factory. All kinds of Taxidermists' supplies. Complete catalog FREE. J. W. Elwood Co., 223 Elwood Bldg., Omaha, Nebraska.

"HOW TO MOUNT ANIMALS," booklet 98¢. Eyes, Scalps, Horns, supplies. Already mounted Deer, Elk, Fur rugs, Birds, Fish. Hofmann, 981-A Gates, Brooklyn 21, N. Y.

TELESCOPES

SKYSCOPE, the new 3½" reflector. Precision ¼ wave aluminized mirror. Sixty power Ramsden type eyepiece. Equatorially mounted on sturdy metal legs. Used by schools, universities. Price complete $19.75. Write for descriptive literature. The Skyscope Company, Inc., 475 Fifth Ave., New York 17, N. Y.

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SELL IN THREE MONTHS OR MONEY BACK If you can write correct English—You can write Juveniles. I have sold some 3000-3500 stories . . . articles . . . editorials . . . serials . . . series. Now I'm teaching. "Instruction—Criticism—Collaboration." Write Dept. N for terms. Will Herman. Author of "My Juvenile Success Secrets" and "My Formula for Fiction." 5703 Broadway—Suite No. 4, Cleveland, O.

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Under the Microscope

By JULIAN D. CORRINGTON

PHOTOGRAPHS COURTESY OF BAUSCH AND LOMB

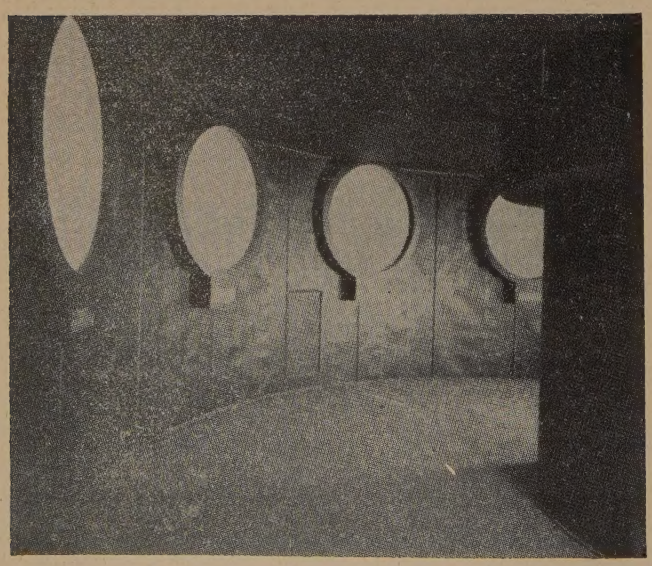
PUBLIC EXHIBITIONS IN MICROSCOPY

In microscopy, as in other divisions of the crafts and sciences, there is frequently the necessity or demand for display of one's special findings so that others may see and profit. The beginning amateur, who works up such proficiency as a mounter of insect mouthparts that he is asked to exhibit his slides at a club meeting, may later become the recognized professional authority on some phase of microscopy or technique, details of which he is requested to display and explain before a national meeting of a scientific society. Either the private or public institution usually finds it much to its own advantage, as well as to the advancement of scientific knowledge in general, to acquaint the public with what it is doing, by means of visual demonstrations.

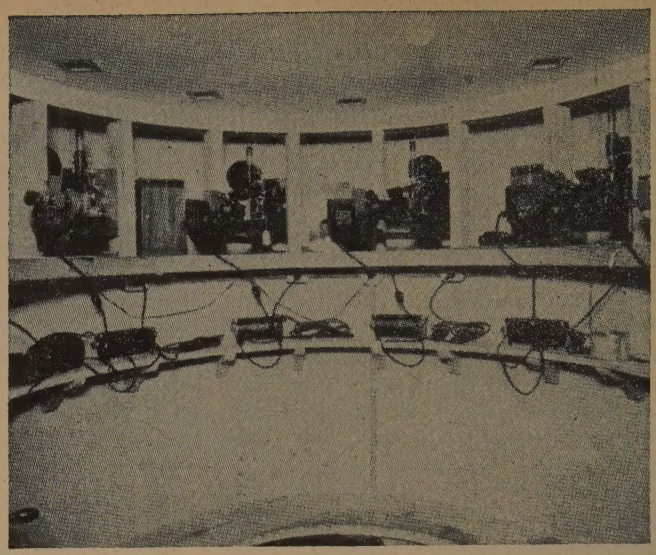
There are many avenues of approach to the problem of showing others what you have arranged under your microscope. Fundamentally, the many choices of procedure fall within one of three methods: microscopes, projectors, or replicas, as models, drawings, or photographs. A few basic principles will serve to clarify the aims of these operations.

By no method, either of direct observation for individuals or display for groups, do we see the actual object itself. The simplest case is that of looking at a small insect through a hand magnifier. The observer sees a virtual image of the insect, not the insect itself. This example is like the one of looking at the reflection of your companion in a plane mirror; you view a virtual image of the friend, not the person itself; with the magnifier this virtual image is enlarged, with the mirror it is not. For purposes of this discussion we may refer to either of these parallel cases as vision once-removed.

Using a compound microscope, we scan a real image of the object, not the thing itself, and enlarge this image again through a simple magnifier that gives a final virtual image of the real image—vision twice-removed. We may project the real image on a screen and observe it, or capture it permanently as a photographic print, and look at this replica; in neither case are we more than twice-removed from the original; or, in other words, we are as near to it optically as in looking through the microscope at the original object.



Six Micro-Projectors show microscopic life on these screens in the circular enclosure of the University of California Science Exhibit.



The projectors, with microscopes and rheostats, are shown in this cylindrical booth with port holes above the heads of spectators.

There is little point, then, to the commonly held notion that looking at photographs is inferior as a method because "it isn't the thing itself." Even when we project photomicrographs on a screen, as with motion pictures of living protozoa, or kodachrome stills of textile fabrics, cases in which vision is thrice removed, the results are in no wise less accurate or representative than if it were possible to view a direct enlargement of the objects themselves. Accordingly, choice of the method to be used should demote to third place the degree of removal of display from source, and should be based, first, on the nature of the material to be exhibited and the story it should tell and, second, on the type and size of the audience. Incidentally and personally, we object to the necessity of employing the word "audience" for such gatherings, and propose the parallel *visience;* lexicographers take heed!

Microscopical societies and clubs usually have stated exhibition meetings, the *conversaziones* of European societies, and, commonly, an annual public exhibition. Those attending will include mainly relatives and friends of members, or visitors with similar interests, and will seldom be too numerous for the time-honored method of display of objects mounted under individual microscopes. The exhibitor stands adjacent to his microscope(s), ready to supplement the label cards with further descriptions, or to discuss his mounts with anyone showing a glimmering of intelligence in the proper direction. So, also, the one-man show at a seminar or club meeting, or the demonstrator at a national technical gathering. The only requisites are to use the very best available equipment, to see that everything is scrupulously clean, and that focusing, illumination, labeling, and the like are accurate and adequate.

For the more or less permanent public display, as in city or world's fair halls of science, museums of science and industry, and similar situations, one possibility is the coin-operated microscope, which may be ordered from the manufacturer so as to function without the use of a coin, if preferred. These instruments may display single subjects, but ordinarily there would be little point in having them so designed; usually the viewer may, by turning a knob, change the subject through a series. Here there is opportunity to mount a succession of related slides on a drum carrier within the housing, such as will tell a

Bausch and Lomb coin-operated microscope.

story or acquaint the observer with little-known specimens, or provide the opportunity of "seeing the actual specimens" of objects that are well known only by reading. We have already noted that our observer does not see the specimen itself, and that what he does see is no closer to that specimen than is a photograph, but the customer, even one trained in microscopy, does not think of this and the psychological effect is to make such a view far more desirable and interesting than the mere inspection of a collection of pictures.

For such an instrument, the subjects must be carefully chosen, with the following points in mind. The public is bound to "monkey" with any movable parts, and some of the spectators, particularly small boys, will abuse anything capable of being maltreated. Therefore the focus must be fixed (unless an attendant is provided), the housing must be formidable in its sturdiness, the lighting uniform for all mounts; hence all of the objects must be more or less uniform in size, and the mounts of approximately equal thickness and intensity of staining. All this in addition to selection for the information the slides are to impart and their interest-arousing properties.

If all the subjects are diatoms, then it is a simple matter to select the proper lighting and magnification to display most species effectively; but an enlargement suitable for water fleas, as daphnia, would be quite unsatisfactory for diatoms. Series of embryos, external parasites, stem sections, textiles, and mineral crystals are examples of subjects that lend themselves for use with this class of exhibition instrument.

The Bausch & Lomb wide-field tube is an inexpensive compound microscope that goes a step farther in that each preparation is mounted under a separate magnifier. Thus, the Chicago Zoological Park constructed pentagonal housing for five of these tubes, (See *Nature Magazine* for May, 1947) and provided a step on each face for small children, that did not interfere with observations by adults. A single bulb in the apex illuminated all five instruments, and an attendant was on hand to assist in focusing, done by raising or lowering the covered depression slides housing the animals exhibited. First creatures selected to grace these slides were local vermin—bedbugs, head and body lice, dog lice, ticks, and similar tiny camp-followers of modern civilization that, like reptiles, fascinate while they repel the non-scientific observer. Curators reported that the interest in these animals, known only by name to most people, was enormous, and that "we were showing creatures as strange and foreign to our public as the duck-billed platypus."

The wide-field tube is just what the name implies, a mere tube, with objective at one end and eyepiece at the other, with a fixed focus to yield a magnification stated on the ocular, ranging from 5X to 20X. Dispensing with all the other, often very expensive, accouterments of the laboratory compound microscope, such as stand, stage, focusing devices, mirror, and so on, the cost is reduced to a minimum. By the same token, and for the same purposes, the exhibitor may use, if he happens to have on hand, the tubes alone from standard instruments, particularly obsolete or damaged models, or miniature microscopes.

A battery of microscopes of any type may be arranged in a linear or circular series on a table of suitable height, each set up with correct focus and lighting for its own subject, then the whole covered with a box or framework of plywood, so arranged that only the eyepieces protrude through holes to the public view. No access is provided to any person, other than the exhibitor, to any part of the display save possibly a light switch.

Most generally in use at the big exhibits, as world's fairs, is the second method—microprojection—and outstanding favorite among subjects is the "world in a drop of water," or microvivarium"

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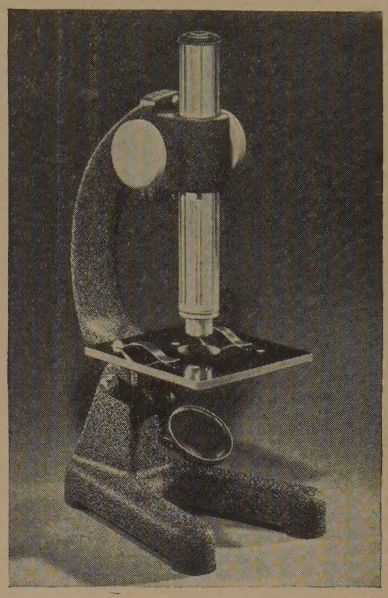

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theme. Expensive, professional equipment, an experienced operator, and a capable lecturer are all necessary for the efficient functioning of this type of scientific entertainment. The same principle can be employed, however, in the home, school, or clubroom, for the edification of small groups, by using the Bausch & Lomb Euscope. The operator looks into a viewing hood and, with a movable stylus, points out various microorganisms and describes what they are doing; the visience sees the same scene, plus the stylus, on an exterior screen, before which they are seated. For larger subjects, living or prepared, the triple-purpose microprojector is admirable. We have published a general account of microprojection in a previous issue (Dec., 1940) of this Department, and will doubtless have more to say on this topic at a later date.

The third method is seldom used alone, but mostly in conjunction with other displays. For example, if a slide you are exhibiting under a microscope shows an unusually fine stage in the reduction division of a spermatocyte of a squash bug—all a strange-sounding jargon to the uninitiated—it is good pedagogy as well as showmanship to have an enlarged drawing or photomicrograph, made from this slide, fully labeled, and with all essential explanatory remarks, lying beside the microscope. The observer studies first one, then the other, possibly back and forth several times, until he feels that he understands what it is all about. Whether he does or not is a secret known only to him—but at least you have done your part.

IMPROVISED LABORATORY EQUIPMENT

Many items for a teaching or research laboratory may be had at little or no cost. If you are outfitting a new laboratory and wish to increase the equipment beyond that allowed by your budget, or if you are establishing a temporary laboratory for summer research, you can improvise many pieces of equipment that will be reasonably satisfactory. We are listing below a few of the commonly used items of this type. You have undoubtedly found others that may be added to the list. If so, we would appreciate your sending in a description of them so that we may publish these suggestions for our readers.

Tin cans may be used as test tube holders or baskets.

A substage light may be improvised by using an ordinary electric light bulb with a Florence flask of copper sulfate solution as a filter. An ordinary desk lamp or a shaded bulb is placed in front of the microscope and the flask attached to a ring stand between the bulb and the mirror of the microscope.

Convenient holders for vials or small bottles may be made by placing the vials in a flat dish or box and filling the surrounding space with paraffin. A second type of holder for the same purpose may be made by boring holes of the desired size in a block of wood.

Reagent shelves or a book case may be made from bricks and boards. Use boards of convenient length for shelves. Place two stacks of three or four bricks each on the floor as far apart as the shelves are long. Place the first shelf on top. Add two more stacks of bricks on this shelf and the second board. As many shelves as are needed may be added in this manner.

A steam pressure cooker ordinarily used for home canning may be used for a sterilizer.

Old automobile windshields make convenient acid-proof tops for working tables. From *Carolina Tips*, leaflet of the Carolina Biological Supply Co., Elon College, N. C.

HISTORICAL OUTLINE

The canning of foods is a vast modern industry that owes its rationalization and modern status to bacteriological knowledge. Preservation of foods by heat sterilization was first accomplished by Nicolas Appert, Parisian confectioner, in 1809, who placed certain foods in glass bottles and kept these in boiling water. In 1810, Appert published *The Book for All Households or the Art of Preserving Animal Substances for Many Years*, winning a prize of 12,000 francs that had been offered by the French Government for the discovery of a practical method of food preservation. But though Appert gained his knowledge through exhaustive trial-and-error experiments and gave directions for many types of food, no logical explanation of the whys and wherefores was forthcoming. Pasteur was still a half-century in the future, and the first *scientific* work on food preservation nearly as much again.

In 1895, Prescott and Underwood, at the Massachusetts Institute of Technology, studied spoilage in a particular lot of canned corn and traced it to imperfect sterilization. The United States Department of Agriculture and a number of university laboratories undertook basic research on problems in this field, and these pioneering studies have been followed up by a constructive program on the part of the National Canners Association and by the can manufacturers. Today, this industry prides itself on its fully scientific basis.

Canning operations begin with careful cleaning of the raw foods, then such preparation of the materials as husking, cutting, trimming, pitting, coring, soaking, sorting, and the like. Immersion in hot water or steam, termed blanching, may follow with such vegetables as beets and carrots, or a precooking, as with meat products, to shrink and drive off gases, effect additional cleansing, or remove unwanted flavors. The cans are then filled and exhausted by heat, expanding the food, driving off gases, and producing a partial vacuum in the can when sealed. Closure of the can by automatic machinery is then followed by the most important step of all, that of heat sterilization, the sealed can being immersed in hot water or a steam bath, usually at a temperature of 240° F. or a steam pressure of 10 pounds. The cans are then cooled, labeled, cased, and shipped or stored.

Heat treatment destroys spoilage organisms that might be in the food, while the sealed can excludes those from the atmosphere which could otherwise reinfect the material.

This immense industry has many important subsidiaries. The processing is performed by complex automatic machinery and only in special cases are operations still done by human hands. Thus, there are separate machines for husking, peeling, washing, grading, filling the cans, sealing them, heating, cooling, labeling, and even casing. The designing and manufacture of so numerous an array of these time- and labor-saving devices is a big business in itself. Then there are the cans. The so-called "tin" can is 98.5% sheet steel, with a thin coating of tin, and the vastness of the industry is made possible by the invention and use of completely automatic machines that turn out cans at the rate of 300 or more per minute. An average of ten billion cans per year is demanded by the mass production methods of this business, there being over 3,000 canneries in the United States, by far the largest producer and consumer of canned foods.

In medicine itself, modern bacteriological research has led off into unexpected channels. As an outgrowth of the staining techniques of Weigert and Ehrlich, applied by Koch to bacteria, investigation has continued ever since as to the effects of dyes on these organisms. From this line of research came work on the dye-like compounds, sulfanilamide and sulfadiazine, adding an important new chapter to medicine. A small note by Fleming, in 1929, describing how some of his bacterial cultures were contaminated by growths of the blue-mold, *Penicillium*, culminated a dozen years later in a still more important discovery,—penicillin. When Burrill decided that pear blight was a bacterial disease, he set off a whole train of investigations that have culminated today in the establishment of an entirely new and very important science,—plant pathology. Plants have their bacterial diseases, just as animals do, and are even more adversely affected by the higher fungi, such as molds, rusts, and smuts.